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BOROUGH OF LEICESTER

21 MAY

A

REPORT

ON THE

PRINCIPAL ZYMOTIC DISEASES

DURING 1877,

BY

DR. WILLIAM JOHNSTON, F.G.S.,

ASSISTANT OFFICER OF HEALTH.

Presented to the Sanitary Committee of the Town Council on
the 18th January, 1878.

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TO THE MEMBERS OF THE SANITARY COMMITTEE OF THE TOWN COUNCIL OF LEICESTER.

Mr. Chairman and Gentlemen,

I beg to submit to you my Report on the mortality experienced in the Borough from the principal Zymotic diseases during the year 1877.

In the following pages I have drawn special attention to the causes of Typhoid Fever and "Summer" Diarrhœa.

To enable me to lay before you last year's Zymotic death-rates for comparison with those of former years, I have taken, as the basis of my calculations, the population as laid down in the official Report of Dr. Crane for 1876.

To W. Jerome Harrison, F.G.S., Curator of the Museum, my thanks are specially due for his kindness in supplying me with Meteorological returns.

I desire also to express my warm thanks to the Town Clerk for the valuable assistance he has rendered me.

I have the honour to be,

Mr. Chairman and Gentlemen,

Your obedient Servant,

WILLIAM JOHNSTON.

Upper Kent Street,

18th January, 1878.

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REPORT

ON THE

PRINCIPAL ZYMOTIC DISEASES

DURING THE YEAR 1877.

In the weekly Mortality Returns of the Registrar General we are given the death-rate which each of our large towns has just experienced. These death-rates fluctuate; at one time a town being subjected to a heavy mortality wave may take precedence of its fellows in the mortality tables, while at another time we observe the same town to have sunk considerably in the death-rates, indicating a comparative freedom from disease. This fluctuation in the death-rates of our towns is found almost invariably to be dependent upon either the prevalence or absence of one or more of the Zymotic diseases.

The seven principal Zymotic diseases are, Small-pox, Scarlet Fever, Measles, Diphtheria, Whooping-Cough, Continued Fever, (Typhus and Enteric) and Diarrhœa. Now all these maladies, Diarrhœa excepted (?), though differing widely in their characteristic local manifestations and general aspect, possess in common one distinguishing feature,—contagiousness, or communicability from the sick to the healthy. By reason of this they all have a tendency to express themselves in wide-spread Epidemics whenever they alight amongst our densely crowded centres of industry. Some of these Epidemics, on account of the great mortality which attends them, may decimate the population of any town they visit. A very interesting and careful inquiry was instituted a few years ago, by order of the House of Commons, to ascertain the number of deaths annually caused by the Zymotic diseases in England and Wales. An annual average was taken from the mortality experienced in the five years, 1864 to 1868 inclusive, and it was found that the annual number of deaths from all causes was 487,765 in an estimated population of 21,210,431 ; and from the seven Zymotic diseases :

Diarrhœa and Cholera ...	...caused	25,165	deaths.
Fever (Typhus, Typhoid & Typhinia)	,,	20,161	,,
Scarlatina	,,	18,659	,,
Whooping-Cough	,,	10,815	,,
Measles	,,	9,208	,,
Small-pox	,,	4,338	,,
Diphtheria	,,	3,644	,,
	Total ...	91,990	,,

In other words 18·85 per cent. of the total deaths arose from the seven principal Zymotic diseases.

This mortality, I confess, is rather uncommon, but it occurred under conditions highly favourable to the propagation of Zymotic diseases ; the most notable being the unusually high temperature together with the continued drought, that prevailed during the months of May, June, July, August and beginning of September of 1868. It affords, however, a striking example of the havoc which Zymotics can work under conditions which favour their development and spread.

During the year 1877 the actual mortality of inhabitants of the Borough of Leicester was 2515. There was a considerable decrease in the total mortality from the seven principal Zymotic diseases compared with that experienced in many former years,—the total number of deaths registered as arising from these being only 358. This number represents a general Zymotic death-rate of a little over 3 per 1000 of the estimated population (117,461) or about 14 per cent. of the total deaths from all causes. These rates bear very favourable comparison with the corresponding ones for the three previous years, as will be seen from the following table :—

TABLE I.

SHEWING THE POPULATION AND TOTAL DEATHS—ALSO THE DEATHS FROM THE SEVEN PRINCIPAL ZYMOTIC DISEASES WITH THEIR RATIO PER 1000 OF POPULATION AND PER 1000 OF TOTAL DEATHS FOR THE YEARS 1874, 1875, 1876, 1877.

	Population.	Total Deaths from all causes.	Total Deaths from the seven principal Zymotic Diseases.	Deaths per 1000 of Population.	Proportion of Deaths to 1000 Deaths.
1874	106,202	2520	398	3·882	156·5
1875	111,000	2889	694	6·252	240·2
1876	113,581	2558	572	5·124	223·6
1877	117,461	2515	358	3·047	142·345

The comparatively low Zymotic death-rate in 1877 was chiefly owing to the marked decrease in the mortality from Diarrhœa and Scarlet fever ; the latter disease having prevailed as an Epidemic during the whole of 1875 and 1876, whilst the deaths from the former were very much below the average number.

TABLE II.

SHEWING THE DEATHS FROM THE SEVEN PRINCIPAL ZYMOTIC DISEASES IN THE 11 YEARS, 1866 TO 1876, AND IN THE YEAR 1877.

Disease.	1866	1867	1868	1869	1870	1871	1872	1873	1874	1875	1876	Proportion of Deaths to 1000 Deaths in 1876.	1877	Proportion of Deaths to 1000 Deaths in 1877.
Small-pox.............	3	2	1	0	0	12	366	2	0	0	0	0	6	2·385
Measles...............	13	2	247	43	42	35	36	62	24	49	50	19·546	40	15·904
Scarlet Fever.........	9	40	9	8	263	112	5	6	18	175	173	67·63	33	13·121
Diphtheria	3	3	10	9	11	7	2	9	8	7	10	3·905	9	3·578
Whooping-Cough....	20	62	6	70	56	32	51	64	43	91	33	12·9	65	25·844
Fever	53	42	63	57	52	65	64	55	48	64	43	16·81	20	7·952
Diarrhœa..............	147	209	349	272	240	303	305	314	257	308	263	102·814	185	73·558
Total..............	248	360	685	459	664	566	829	512	398	694	572	223·605	358	142·345

From Table II, it will be observed that the total deaths last year from the seven Zymotic diseases were less than for any of the preceding 10 years. Now although this marked decrease in the mortality is very satisfactory, still such a number of deaths arising from the above diseases is large, and especially so when we consider that they resulted from causes acknowledged to be, in great measure, preventible.

* * *

CAUSES OF DEATH.

SMALL POX.

Last year this truly loathsome disease again appeared in the town in its most malignant form, after an absence of more than four years.

Six deaths were registered as having occurred from the malady, only 5 however resulted from it : about two months previous to its first appearance and spread a death took place which was certified as Small-pox, but from information subsequently obtained with respect to it I have no hesitation in saying that the case was not one of Small-pox.

The small mortality experienced from the visitation of the disease was chiefly owing to the unremitting zeal displayed by the Sanitary Inspectors (Sergeants Buxton and Braley) in rapidly transporting to the Borough Fever Hospital those suffering from the disease when once they gained information respecting them. The disease was hæmorrhagic in character, and affected altogether 12 cases ; out of these 5 succumbed, shewing a mortality of 41·6 per cent. which is by no means a high death-rate if the fatal character of this variety of the malady be taken into account. After most careful enquiry I was unable to trace the source of the primary infection but the eleven succeeding cases were found to have received it from the first affected.

Now of the 5 fatal cases, 3 were vaccinated and 2 un-vaccinated. Of the three vaccinated cases one was a man in his 59th year, who had been vaccinated when he was three months old, and therefore any protection which the operation afforded had ceased to exist long before his demise. Neither of the other fatal cases had been efficiently vaccinated, exhibiting as they did, small and imperfect cicatrices.

As the plan which I adopted in the removal of these cases is novel, and may be found useful by Officers of Health in other towns for preventing the spread of the disease, I may be pardoned if I again draw attention to it. In any house where a Small-pox case occurred I endeavoured to impress the inmates with the fact that the removal of *all* the members of the family to the Hospital was the best course to adopt, not only as regarded their own individual welfare, but also that of the town at large. And I am glad to say that all complied with my request, left their infected habitations and became inmates of the Hospital. Altogether 22 unaffected cases were thus admitted into quarantine, and of these, three after admission sickened. The first case sickened in 48 hours, the second in 72 hours, whilst the third shewed no symptoms of the disease until the 12th day. Now all these cases must have been infected before admission as Small-pox appears on the skin on the 14th day after the infection of the disease has been received into the system. The epidemic had got firm footing in the town, as it expressed itself in no less than six places, viz. Birstall street, Chester street, Gresham street, Argyle street, Watling street, and Newby street.

The suppression of what might otherwise have proved a widespread epidemic attended with great fatality was entirely due to the *early information* received of the cases affected and the promptitude observed in their removal.

As immediate reporting of the cases is of paramount importance in their limitation, it is most desirable that the Corporation of Leicester should endeavour to obtain from Parliament authority to compel the registration of infectious disease within the Borough.

Huddersfield and Bolton have each obtained such authority from Parliament.

The following is an extract from the "Bolton Improvement Act," 1877, which relates to this matter :—

SECTION 87. In order to secure that due notice be given to the Corporation of any inmate of any building used for human habitation who is suffering from Small-pox, Cholera, or any contagious or infectious fever the following provisions shall have effect (that is to say) :

(1) If any such inmate be suffering from any such disease as aforesaid the occupier or person having the management or control of such building shall as soon as he shall become aware of the existence in any such inmate of any such disease forthwith give notice to the Corporation at the town hall of the existence in such inmate of such disease.

(2) If such inmate be not a member of the family of such occupier or person the head of the family (resident in such building) to which such inmate belongs or if there be no such head then such inmate (unless prevented by reason of such disease or of youth) shall on becoming aware of the existence in such inmate or in his own person as the case may be of such disease forthwith give notice thereof to such occupier or person.

(3) The Corporation shall provide and supply gratuitously to every registered medical practitioner resident or practising in the Borough forms for the certificate or declaration by such medical practitioner of the particulars hereinafter mentioned in relation to such cases according to the form set forth in the Fifth Schedule to this Act.

(4) Every medical practitioner attending on or called in to visit such inmate shall on becoming aware that such inmate is suffering from any such disease as aforesaid forthwith fill up sign and send to the Corporation at the town hall a certificate or declaration stating according to the forms prescribed and supplied to him by the Corporation the name of such inmate the situation of such building and the name of such occupier or person and the nature of the disease from which such inmate is suffering.

(5) The Corporation shall pay to every medical practitioner who shall in pursuance of this section duly make and give any such certificate or declaration a fee of two shillings and sixpence for each such certificate or declaration;

And any person who shall offend against this enactment (unless ignorant thereof the burden of the proof of which shall be on him) shall for every such offence be liable to a penalty not exceeding ten pounds.

THE FIFTH SCHEDULE.

CERTIFICATE OF DISEASE UNDER SECTION 87.

Bolton Improvement Act, 1877.

SECTION 87.

To the Corporation of the Borough of Bolton.

Pursuant to the above-mentioned Act I hereby certify and declare that in my opinion the under-mentioned person is suffering from a disease within the terms of such section.

Dated the day of 18 .

(Signed)

Name of person suffering from the disease.

Situation of the building wherein such person is.

Name of occupier or other person having the charge management or control of the building or room.

Nature of the disease.

NOTE.—This certificate must (under penalty of five pounds in case of neglect) be forthwith sent to the Corporation at the Town Hall and delivered to the offical clerk or servant of the Corporation who shall be found in attendance there.

With such authority, immediate knowledge would be gained of Small-pox cases existing in Leicester, and with the Hospital complete isolation is already secured; under such conditions it would therefore be highly improbable that this disease should ever again prevail in the town as an epidemic.

MEASLES.

Last year there was a considerable diminution in the mortality from this disease when compared with that of the two previous years. The total deaths in 1875 were 49; in 1876, 50; but in 1877 only 40 deaths occurred.

SCARLET FEVER.

The epidemic of Scarlet fever which commenced in 1874 and caused great mortality during 1875 and 1876 rapidly declined in 1877, the deaths from the disease only numbering 33; those in 1875 were 175; and in 1876, 173.

WHOOPING-COUGH.

There has been a considerable increase in the number of deaths over that of 1876, the number being 65 for 1877 and only 33 in 1876. This increase in the mortality from the disease was, in all probability, owing to the unusually low temperatures experienced during the summer months giving rise to an increased prevalence of "colds" amongst children, which state very much enhances their predisposition to the disease.

FEVER HOSPITAL.

During the first half of last year the total cases admitted into the Hospital were 15; during the second half of the year there were 55.

Of these 55 cases: 12 of them were suffering from Small-pox, 5 of which proved fatal.

Five cases were affected with Erysipelas, and of these one proved fatal. In justice to myself I must here state that this fatal case was that of an aged man who was in a moribund condition when admitted.

The remaining 38 cases were suffering from Scarlet fever and I am glad to state that no fatality occurred amongst them.

The total mortality therefore amongst the 55 cases has been 10.9 per cent. which is an unusually low death-rate for an infectious-disease Hospital.

* * *

INFANTILE MORTALITY.

The human organism during infancy and childhood is most delicate and highly sensitive to external influences, and in a manufacturing community the death-rate attending these periods of life is found to afford more trustworthy evidence, and to form a better guage of its sanitary condition than that of any adult age whatever. Excessive rates of infant mortality are almost invariably met with in urban populations, and it has been stated on high authority, "that if we strike out of the calculation (of general mortality) all the deaths of children under 5 years old, the average mortality of the 63 selected *rural* districts is scarcely 2½ per 1000 lower than that of the 30 most fatal *town* districts of England*.

It is important also to bear in mind that (*a*) in town populations the greatest proportion of the deaths of children under five years occurs amongst infants under one year old, and (*b*) there exists a wide range in this rate of mortality amongst infants in different towns.

The great mortality encountered by infants is, I consider, to a material extent dependent upon maternal neglect. This neglect on the part of the mothers is not, I need scarcely say, wilful, but arises from their absolute ignorance of the laws to be observed in the dispensing of proper aliment to their offspring. In England thousands of infants die annually, and thousands more fall an easy prey to any prevailing Zymotic disease, through the degeneracy of constitution which results from insufficient, careless, or improper feeding.

The statistics of the Registrar General inform us that out of every 1,000 children born, 150 die before they reach the age of one year, and about one-third of these deaths are attributable to what may be called starvation-induced diseases. Now the number of children born annually in the United Kingdom amounts to close on a million; there is, therefore, an annual sacrifice of at least 50,000 infant lives caused through insufficient, or, what is almost as bad, improper feeding.

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* "Fallacies of Statistics," by W. H. Rumsey, M.D.

If a mother be in fairly good health and moderately careful with regard to her diet, the proper food for her infant is the milk from her own breast. This is, in the vast majority of cases, amply sufficient both in quality and quantity, and should constitute the only food of a child until the appearance of the teeth enables the mouth to deal with solid food. Many mothers (and these are not confined wholly to the artizan and poorer classes) consider that their breast milk, though abundant in supply, is insufficient to "feed" the child, and the consequence is that in a week or so after its birth, the infant is in the course of each day repeatedly crammed with unwholesome and indigestible food—milk thickened with arrowroot, rusks, tops and bottoms, or biscuits of various kinds Children whose stomachs are in this way regularly overloaded with such unnatural food, though healthy, blooming, and plump at birth, soon exhibit signs of mal-nutrition, they gradually diminish in weight and become pale and flabby, they more or less constantly cry, look feeble and languid, and grow less energetic in their movements. These changes are as a rule accompanied with diarrhœic discharges, vomiting and prostration, and emaciation more or less excessive follows as a result of these. The mother, judging from the wasted form of her child, either perseveres with, or, as is the case in many instances, increases the amount of the non-nutritious aliment, and occasionally administers a dose of "Gripe Water," "Mother Winslow," or "Godfrey," with a view to relieve the child of the colicky pains from which it evidently suffers. The infant in the meanwhile grows more and more emaciated, acquires a sallow and sunken appearance, moans continuously, and, in a period that varies according to its previous constitution from a few weeks to as many months, at last dies, either from Convulsions, Debility, Atrophy, or Diarrhœa.

I have now had sufficient experience in the treatment of infantile diseases in Leicester to warrant me in affirming that many children in the town are annually lost by being fed in the manner I have above described. Leicester, however, is not peculiar in this respect, for the same maternal negligence and ignorance are found to prevail in all the other large manufacturing towns in England where factories exist that require female labour. Much the same state of matters is also found to exist in other countries where the subject of the improper feeding of infants and its results has been thoroughly investigated.

Professor F. A. Kehrer, of Giessen, in his article on "The Food of Infants," says, "You may lay stress upon the fact that human milk, because more rapidly digested than cow's or any other milk, wards off many diseases to which the child's digestive organs are prone, excites a more rapid and vigorous growth, and finally, that its use is associated with a far lower rate of mortality among children than is found to attend the employment of all other natural and artificial foods. There are many statistics to this effect, but the following will serve to prove what has just been said. C. Meyer found that of 8,329 children, six months old and under, who died in Munich from 1868 to 1870, 1,231 (*i.e.* 14 per cent.) had been suckled, and 7,078 (*i.e.* 84·9 per cent.) brought up by hand. Figures such as these have a more distinct meaning than a host of words."

If a mother, through ill-health or from having to earn her living by out-door work in a factory, be compelled to rear her infant artificially, the food she provides for it should consist of fresh unadulterated cow's milk, which should not be supplemented by or thickened with farinaceous foods, such as arrowroot, corn-flour, and the like. The quantity of milk required for a new-born infant has been ascertained to be a quarter of a pint on the second day, two-thirds of a pint on the third and fourth days, and a whole pint up to the end of the first month. After this the quantity may be gradually increased until the child reaches its sixth month, when not less than two pints are required. The quantity of aliment given to the child is not, however, all that is required of the mother, for in addition to this, *punctuality must be observed in giving the child its meals*, if we wish it to remain healthy and be well-developed. The quantity of milk to be provided and the times of giving it have been computed by Bouchut (*Journal Official*, Nov. 23rd, 1870.) in the manner given below :

1st	Month,	10	meals daily of	4	tablespoonfuls	of fresh	Cow's Milk.
2nd	,,	9	,,	6	,,	,,	,,
3rd	,,	8	,,	8	,,	,,	,,
4th	,,	7	,,	10	,,	,,	,,
5th	,,	7	,,	12	,,	,,	,,
6th	,,	7	,,	14	,,	,,	,,

After this period the diet should be supplemented by various articles, such as a little beef tea, arrowroot, gruel, baked flour, &c.

I have at the risk of being considered too lengthy, entered thus far into the dietary of infants for the purpose of shewing that it is impossible for mothers engaged in factories to bring up their children properly, and that the women who are left to care for them during the mother's absence will not take upon themselves the necessary trouble.

As long therefore as out-door female labour is required in Leicester for the various manufactories, the mortality that arises from improper feeding will continue. The only way by which the above conditions can be abated is by the establishment of *Crêches* or public Nurseries, where the children may be fed and nursed during the day at a trifling cost. A *Crêche* of this kind we hope shortly to see established in Leicester, and I look with confidence to the Corporation for some portion of aid in the support of this much-to-be-desired Children's Home.

DIARRHŒA.

CHAPTER I.

One hundred and sixty-six fatal cases of Diarrhœa were registered in the Borough of Leicester during the three months ending September 30th, 1877. Of these, 4 cases were adults whose ages were 38, 63, 72, and 79 years respectively. There were also 8 infantile cases about which I could gain no reliable information, the parents having either changed their residence or left the town altogether. Full information was obtained in the remaining 154 cases.

I shall begin with the parents :

1st As regards the *Health* of the parents :

(*a*) Of the 154 fathers,

131 were in good health=85 per cent.
23 ,, poor ,, =14·9 ,,

(*b*) Of the 154 mothers,

114 were in good health=74 per cent.
37 ,, poor ,, =24 ,,
3 ,, bad ,, = 1·9 ,,

I have used the terms "good" and "poor" in their generally accepted sense, good health meaning a vigorous condition of body, and poor health a weakly condition which more or less interferes with the due performance of daily duties. The three mothers in "bad" health were consumptive.

From the above calculations we ascertain that of the total 308 parents, no less than 245 or 79·5 per cent. were in good health. This, I think, requires no comment, inasmuch as it indicates a scale of health if not equal to, at least favourably comparable with that of those parents whose children enjoyed an immunity from the disease.

2nd, As regards the *Ages* of the parents.

(*a*) Of the 154 fathers,

2 were under 20 years (17 and 19).
34 ,, over ,, and under 25 years.
118 ,, 25 years and upwards.

(*b*) Of the 154 mothers,

3 were under 20 years (15, 17, and 19).
42 ,, over ,, and under 25 years.
109 ,, 25 years and upwards.

This table clearly shews that early marriages, whatever their influence may be in other towns, have little or no effect in increasing our summer death-rate from Diarrhœa.

Upon inquiring whether the mothers were engaged in out-door work or not, I found that of the 154 mothers, 108 or 70·1 per cent. did *not* go out to work during the day, and 46 or 29·8 per cent. were employed in work which necessitated their daily absence from home. This per-centage of mothers engaged out is very much less than is found to exist in some manufacturing centres where female labour is employed, as for instance in Leeds, Macclesfield, Oldham, Huddersfield, Salford, &c.

Under the head of Infantile mortality I have shewn that a certain number of deaths amongst children throughout the country are annually caused by improper feeding, and through the neglect which necessarily follows when the mothers are engaged in out-door employment. Leicester, I have no doubt, in common with other towns contributes its share of these cases. The above causes are, however, *constant in operation*, and the deaths arising from the diseases which they induce (atrophy, debility, convulsions, and diarrhœa,) occur more or less regularly throughout the whole year and are not confined to any particular period. It is therefore evident that although some of the 162 children, who died in Leicester from the epidemic of Diarrhœa, may have sunk from maternal neglect, nevertheless the per-centage of deaths arising from this cause could not have exceeded that in other towns, and would not by any means account for the excessively high proportionate death-rate experienced during last summer quarter.

I shall now consider the ages, health, and food of the infants :

1st. As regards the *Ages* of the infants.

130 were under 12 months.
20 ,, from 12 months to 2 years.
3 ,, from 2 to 5 years.
1 was a little over 5 years.

Thus only 24 or 15·5 per cent. of the 154 children had, at the time of death, completed their first year.

2nd. As regards their *Health*.

103 infants were in good health.
51 ,, ,, weak ,,

In other words 66·8 per cent. were quite healthy infants when born.

3rd. As regards their *Food*.

90 infants were suckled=58.4 per cent.
30 ,, bottle fed=19·5 per cent.
34 ,, fed upon a mixed diet=22 per cent.

The pernicious effects of a mixed diet (milk thickened with arrowroot, baked flour, sago, &c.) I have already referred to ; the only fact which I here wish to be particularly noted is, that no less than 58·4 per cent. of the infants were suckled by the mother,—a per-centage very much greater than has been found on previous inquiries. This increase over previous years in maternal nursing does not appear to have had any material effect in improving our position in the national mortality returns, for it will be seen by referring to the summary of the Registrar General's quarterly report for last summer, that Leicester and Liverpool experienced the highest Zymotic death-rate (6·6 per 1000) of any of the 20 large English towns (Wolverhampton excepted). "Whooping-Cough and Diarrhœa caused the high rate in Liverpool, Diarrhœa was exceptionally fatal in Leicester, and Scarlet fever caused the high Zymotic rate in Wolverhampton."* This again furnishes additional proof that our proportionally high infantile death-rate from summer Diarrhœa does not depend upon the neglect of Leicester mothers.

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* Vide *Public Health*, Nov. 9th, 1877.

The Duration of Illness.

81 or 52·6 per cent. of the infants were ill for a week or under.
51 or 33·1 „ „ „ „ between 1 & 2 weeks.
22 or 14·2 „ „ „ „ over 2 weeks.

More than half of these infants, therefore, perished during the first week of their illness.

THE SANITARY CONDITION OF THE PREMISES WHERE THE DEATHS OCCURRED.

1st. AS TO YARD.

132 or 85·7 per cent. were in good condition, having open and well-scavenged yards attached.

19 or 12·3 per cent. had rather confined yards.

3 or 1·9 per cent. had no yard.

2nd. AS TO WATER SUPPLY.

117 houses were supplied with Waterworks water=75·9 per cent.
37 „ „ „ Pump „ =24 „

3rd. AS TO CLOSET ACCOMMODATION.

95 houses had pails=61·6 per cent.
47 „ water closets=30·5 per cent.
12 „ privies=7·8 per cent.

These figures speak for themselves. They indicate, as far as the houses are concerned, a sanitary condition almost as perfect as permissive sanitary legislation will admit of.

They also go far to prove the correctness of the statement which I made some twelve months ago to several members of the Sanitary Committee, viz.: *that Leicester (taken in its entirety) for the cleanliness and width of its streets, the free ventilation of its yards, and the general neatness of its artizan homes, is unsurpassed by any large manufacturing town in England.*

Chapter II.

In the previous chapter I have used the term "Summer" Diarrhœa to indicate the disease which gives rise to the unusual number of deaths amongst children under five years of age during the third quarter of each year. In employing this term I do not wish to imply that the disease at this season presents anything distinctive, anomalous, or specific in its nature, for, as seen in Leicester, the features of the disease do not differ in the least degree from those observed in infantile cases of Diarrhœa in other English towns during the same quarter. The wide variations in the mortality from the disease that are observed to exist amongst urban populations do not, therefore, arise from an unequal distribution of a specifically virulent form of the malady, but from the fact that the number of cases affected is greater in one town than in another. The *British Medical Journal* (Dec. 22, 1877), in its article on the "Geography of Preventible Disease," says, "The exceptionally low temperature of the past summer caused the fatality of Diarrhœa, principally infantile, to be lower during the three months ending last September than it had been in the corresponding period of any year since the cold and wet summer of 1860. The annual death-rate from Diarrhœa in the whole of England and Wales last quarter was equal to 1·31 per 1,000, whereas in the seven preceding corresponding quarters it had averaged 2·53. In the mainly agricultural counties of Dorset and Wilts the death-rate from Diarrhœa did not exceed 0·31 and 0·32 per 1,000, while it was equal to 2·03 in Lancashire, 2·79 in the East Riding of Yorkshire, and 2·90 in Leicestershire. In London with its three and a half millions of urban population, the death-rate from Diarrhœa was equal to 2·00 per 1,000, and was lower than the rate in any of the three last-mentioned counties, each of which has a considerable proportion of rural population. In 20 of the largest English towns the Diarrhœa rate averaged 2·3 per 1,000, and ranged from 1·5 in Bristol and Bradford to 3·4 in Portsmouth, 4·6 in Hull, and 5·6 in Leicester. In fifty other large town districts the diarrhœa rates showed equally marked variations, while the rate averaged 1·5 in the fifty towns, it ranged from 0·2 in Swansea, and 0·3 both in Merthyr-Tydvil and Halifax, to 3·8 in Preston, 4·0 in Wigan, and 5·4 in Yarmouth. *Leicester and Yarmouth, as in recent years, again showed conspicuously excessive death-rates from Diarrhœa, the real causes of which are little more known now than they were when they first seriously attracted the attention of hygienists a few years since.* Diarrhœa, whether a distinct filth-disease or only a symptom, plays so important a part in the causation of infant mortality that it calls for further investigation at the hands of public health professors."

Now although the deaths from Diarrhœa last summer quarter were less in the town of Leicester than they had been in the corresponding period of any year since the summer of 1867, still, as will be seen from the above extract, the death-rate that was experienced from this disease was sufficient to place the town (as in former years) foremost in the Diarrhœa-rates of the twenty largest English towns.

On the other hand it is observed that during the winter months when Diarrhœa does not prevail, the position which Leicester occupies in the general mortality returns is as favourable as it was previously deplorable.

This contrast will be easily seen by a perusal of the following extracts. In its issue of August 24th, 1877, *Public Health* says: "The annual rates of mortality per 1,000 last week in the 20 large English towns, ranged in order from the lowest, were as follows:

Brighton	18
Sheffield...	19
Newcastle	19
London	19
Wolverhampton... ...	20
Bristol	20
Sunderland	20
Bradford	21
Plymouth	21
Portsmouth	21
Manchester	22
Leeds	22
Oldham	23
Salford	24
Hull	26
Liverpool	27
Birmingham	28
Norwich...	28
Nottingham	32
Leicester	33

In its issue of December 21st, 1877, the same *Journal* says: "The annual rates of mortality per 1,000 last week in the 20 large English towns, ranged in order from the lowest, were as follows:

Portsmouth	17	Newcastle	24
Leicester		Norwich	24
Hull	18	Leeds	25
Brighton	20	Plymouth	25
Bradford	21	Sheffield	25
Bristol	22	Sunderland	26
Birmingham	23	Wolverhampton	26
London	24	Nottingham	26
Oldham	24	Liverpool	27
Salford	24	Manchester	29

This extreme alteration in the last return as regards the position of the town amongst urban death-rates, is to be attributed almost entirely to the diminished prevalence of infantile Diarrhœa.

In entering upon an enquiry as to the causes of the excessive infantile mortality from Diarrhœa in Leicester, I think the best plan to adopt is first, to ascertain the years that were most noted either for the prevalence or scarcity of the disease, and afterwards to note the climatic conditions that prevailed in the summer quarter of each of these years.

From the following table it will be seen that the years in which there was the greatest mortality from the disease were 1868 and 1873, and of the years in which there was much less mortality, I shall take for future consideration 1866, 1875, 1876, and 1877.

Mr. W. J. Harrison, Curator of the Town Museum, very kindly supplied me with the meteorological returns for these years. The complete returns will be found in the Appendix; some of them I have, for convenience of reference, here tabulated on the following diagrams. They show the maximum and minimum temperatures for each day and their averages for the quarter. The rainfall I have indicated by shading as many squares as there have fallen tenths of an inch, whilst the curve underneath represents the number of deaths from Diarrhœa.

TABLE III.

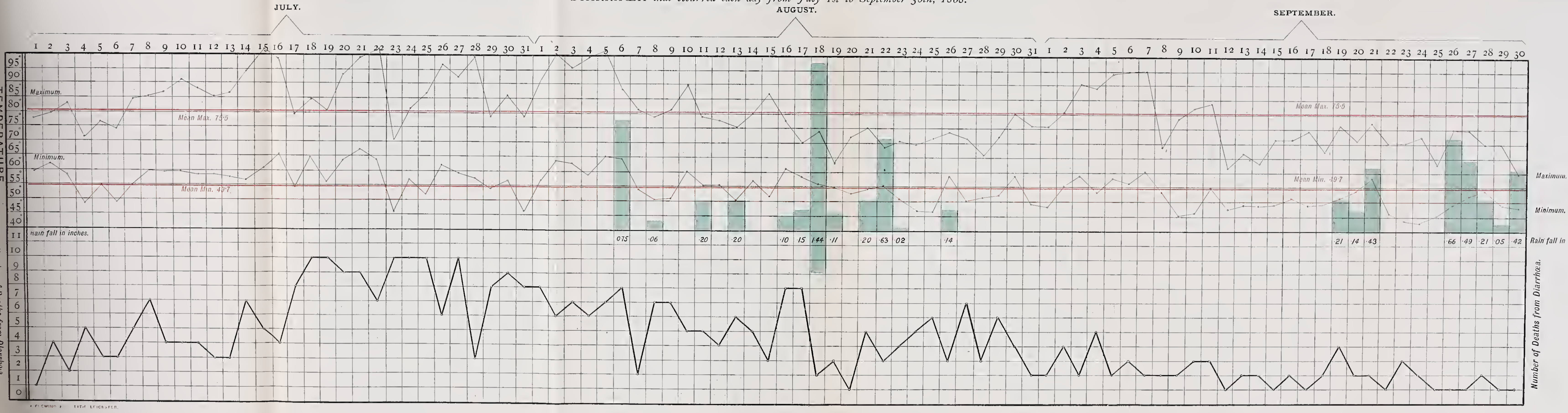
Shewing the Population, and Deaths from Diarrhœa of Children (5 years and under), during the third quarter of the year 1877, and the eleven preceding corresponding quarters, also the total Rainfall in inches and the average maximum temperatures for the same periods.

	Population.	Deaths from Diarrhœa.	Maximum Temperature.	Rainfall in Inches.
1866	83,750	96	68°·3	12·5
1867	86,000	144	71°·4	6·66
1868	90,000	319	75°·5	6·61
1869	91,500	187	73°·5	4·69
1870	92,750	188	73°·6	3·60
1871	95,882	245	71°·4	9·73
1872	99,143	240	72°	11·60
1873	102,515	258	70°·5	6·47
1874	106,202	209	67°·6	5·90
1875	111,000	238	67°·3	11·83
1876	113,581	230	69°·2	8·38
1877	117,461	162	64°·7	6·82

After a most careful study of these tables I am firmly convinced that "Solar heat" is the chief agent in generating the disease.

In the year 1868, the mortality from the disease amongst a population of only 90,000 was greater than has ever (either before or since) been recorded. On referring to the Chart for that year it will be observed :

CHART shewing the MAXIMUM, MINIMUM, and MEAN TEMPERATURES, and RAINFALL in INCHES, with the number of DEATHS from INFANTILE DIARRHŒA that occurred each day from July 1st to September 30th, 1868.



21 MAY 90

(*a.*) That very high temperatures prevailed.

(*b*) That when the rain first appeared (August 6th), the height of the epidemic had already passed. Almost 200 of the total 319 deaths had by that time taken place, and many of those who subsequently succumbed to the disease had already acquired it.

(*c*) That the rainfall of the 6th, 18th, and 22nd of August was large, and on its appearance a marked diminution took place in the mortality.

(*d*) That the gradual diminution subsequently observed in the mortality was not interrupted by any decided increase of deaths supervening upon the high degrees of heat experienced during the first days of September.

This August rainfall, it is evident, must have effected such changes in the general condition of the town as to render the high September temperatures comparatively inoperative.

On looking over the meteorological returns for the months of May and June of this same year, I find that there was only half-an-inch of rainfall recorded for the whole of May, and but one-third of an inch for the whole of June. Unusually high temperatures also prevailed throughout the whole of these two months.

It will therefore be seen, that in the year 1868 an almost unprecedented degree of heat was experienced which lasted for over three months (counting from May 1st), and that the rainfall from May 1st to August 6th (a period of 97 days), only amounted to three-quarters of an inch. These conditions, as has been pointed out, gave rise to the highest recorded mortality. Now this unusually high mortality must have arisen solely from the fierce heat that prevailed acting upon some local conditions that favoured the development of the disease, for it could in no way have been supplemented by the rainfall, as this was, up to August 6th, too small in amount to have exercised the slightest influence in the causation of the disease. The rainfall that occurred on that day (which was 12 days *after* the acme of the epidemic) and the following days in August exerted, as has been seen, a preservative more than a destructive influence.

Again, if reference be made to the Chart for the year 1876, it will be observed that each rapid increment of the *maximum* temperature was *followed* at pretty definite intervals by an increase in the number of deaths, as indicated by the mortality curve; thus, high temperatures were experienced on the 16th and 22nd of July, and also on the 9th, 13th, 14th, 15th, 16th, 17th, and 21st of August, and these temperatures were followed by high death-rates on the 22nd July, and 1st, 12th, 16th, 19th, 22nd, and 27th of August.

A high death-rate *following* the temperature which has induced it is easily explained by the fact that a variable time elapses between the infliction of the disease and its fatal termination.

The rainfall in 1876 was small in amount until the acme of the epidemic had been passed by 5 days. It then became more or less continuous, and, being accompanied with a fall in temperature, the mortality is observed to have rapidly subsided.

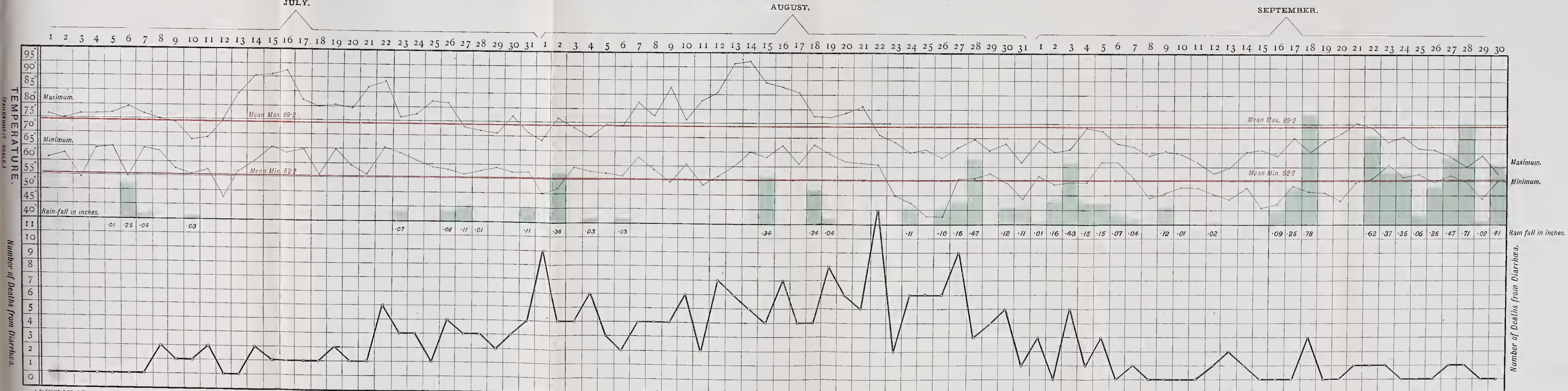
The same connection will be found to exist between the increments of the *maximum* temperature and the mortality of 1877 (vide Chart for 1877).

In the year 1875 the Sanitary Committee determined to make a thorough inquiry into the causes of the summer infantile Diarrhœa, and Drs. Buck and Franklin were appointed to conduct the investigation.

The following extracts are drawn from the Report which embodied the result of their inquiries:—

> "Some parts of this deposit are tolerably porous, others almost impermeable, but it is noticed that this soil recovers itself in two or three days from the effects of a flood. Not so, however, with the low-lying clay of the eastern district, this takes weeks, or more accurately speaking, months, to clear itself of surplus sub-soil water.
>
> In Carley-street, Birstall-street, and Emerald-street, the soil was very damp at the time the sewers were opened for our inspection. Indeed, it is difficult to imagine how the sub-soil in the low-lying parts of the town could be otherwise when we remember the way in which the water in the river is dammed up against the town by the mills. It has been found that sub-soil water does not necessarily drain horizontally to a river, but generally slopes according to the contour of the ground through which it permeates, and it has also been noticed that the rise and fall of a river will affect the sub-soil drainage more than half-a-mile away. In the north-eastern district the houses labour under the disadvantage not only of being situated for the most part on a retentive low-lying flat clay which cannot easily recover itself from surplus sub-soil water,

CHART shewing the MAXIMUM, MINIMUM, and MEAN TEMPERATURES, and RAINFALL in INCHES, with the number of DEATHS from INFANTILE DIARRHŒA that occurred each day from July 1st to September 30th, 1876.



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SURGEONS OF ENGLAND
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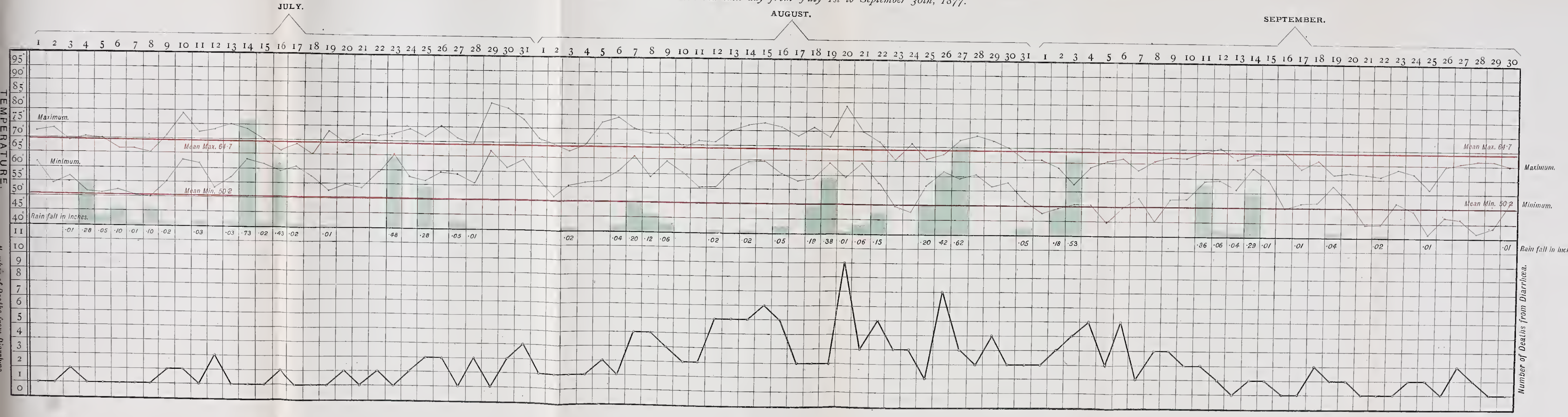
CHART shewing the MAXIMUM, MINIMUM, and MEAN TEMPERATURES, and RAINFALL in INCHES, with the number of DEATHS from INFANTILE DIARRHŒA that occurred each day from July 1st to September 30th, 1877.



OF SURGEONS OF ENGLAND
21 MAY 90
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but also of being near the outfall of the main sewer, which is liable to be blocked up by excess of fluid on a moderate rainfall. Generally speaking the distribution of the disease is determined by the course of the river. The higher parts of the town have but little. The land of the low-lying parts of the north-eastern district of the town, where the concentration of the disease is most marked, consists as just shewn, of clay, of a bed of fine sand, and also to some extent of artificial or "made ground." In the northern and north-western districts the houses are built upon gravel (the old part of the town), and here the deaths are scattered as compared with those on the clay, and their specificity is not so marked."—"Thus it seems to us that heat, in conjunction with a water-logged soil, forms a favourable condition for the production of epidemic Diarrhœa in Leicester. The effect of heat plus moisture is well seen in the deaths about Lyttleton-street in the north, where almost all the cases were of a specific nature. The houses were exactly the same in their arrangements as those we have described in Birstall-street, and the population is not a poor one. The soil, however, was exceedingly damp when we visited the neighbourhood."

Drs. Buck and Franklin, as will be seen from the above extracts, concluded that heat acting on a water-logged sub-soil, being the most general, was the chief cause of the disease and they accordingly placed this in precedence to all other causes. If a water-logged sub-soil be one of the chief conditions in the production of Diarrhœa the town of Leicester was, in the year 1875, in a most favourable condition for the development of the disease on account of the great floods that prevailed. These floods were unparalleled by any since the year 1860.

The question therefore naturally arises, was this thorough saturation of the town's sub-soil attended by an unwonted Diarrhœa mortality? This is fully answered by a reference to Table III, page 26. We there find that the deaths from Diarrhœa, in 1875, were 238, in a population of 111,000. Now this mortality was by no means unusual, for if we refer on the same table to the year 1873, we find that the amount of rain that fell in that year was little more than half the quantity that fell in 1875 and consequently the sub-soil could not have been so saturated, yet we have this improvement as regards the water-logging accompanied by an *increase* of 20 in the number of deaths, the mortality for the quarter being 258, and these in a population of only 102,515.

To account for this increase in the death-rate of 1873, it may be urged that the soil was exposed during the summer to a higher temperature than in 1875. This, however, in no way affords a satisfactory answer, for in 1872 (vide, Table III.) the sub-soil was saturated by rainfall to a degree almost equal to that of 1875, and a higher temperature was experienced than in 1873, yet the deaths in 1872 were again less than in 1873.

Again, from the Chart for 1876, it will be seen that the amount of rainfall, until the acme of the epidemic had passed, was quite insufficient to cause any water-logging of the soil, still the mortality was almost equal to that of 1875.

The rainfall in 1866 was greater (vide, Table III.) than any since recorded, and with a higher temperature prevailing than in 1875, there were only 96 deaths from diarrhœa. This mortality from the disease is the least, in proportion to the population, that the town has ever experienced since the year 1860.

And what were the conditions that prevailed in 1868, a year unparalleled for its high mortality from Diarrhœa? A totally opposite condition to that of water-logging existed, for the soil was everywhere, both in the town and immediate neighbourhood, parched, dry, and arid, through the long continued drought and intense heat experienced.

The above facts clearly prove that heat, in conjunction with a water-logged soil, does *not* form a favourable condition for the production of epidemic Diarrhœa in Leicester.

It must not be supposed, however, that I eliminate altogether the influence of rainfall from the question at issue; on the contrary, I consider that it plays an important part in the causation of the epidemic, but its mode of operation is, in my opinion, entirely different to that hitherto advanced.

Chapter III.

Much disease is induced in districts where, from an entire absence or deficiency of sewers, collections of filth and fæcal matter are allowed to remain and decompose either on the surface of the soil or in open cesspools; but although I am fully alive to the important influence which the gaseous products from such collections exert in the causation of disease, it is not my present intention to dwell upon them. I shall confine my remarks to a consideration of organic effluvia arising from sources similar in nature to the above but generated in sewers, where, owing to confinement, these exhalations attain a higher degree of concentration and exhibit a greater activity in the production of disease.

Ordinary town sewage consists of fæcal matter, urine, soap-suds, slop-water, and liquids from various manufactories, intimately mixed in their transit through a system of sewers. The flow of this mixture depends, as a rule, upon the fall given to the sewers, and if its course be retarded from any cause, the solid particles deposit themselves and form a layer of silt, the thickness of which will depend upon the time the obstructive cause is in operation. The silt thus collected, like all other collections of dead organic matter, soon undergoes decomposition, and this process is very much accelerated if heat be also present. Gaseous products result and are given off in variable quantities; amongst these we discover marsh gas, carbonic acid, sulphuretted hydrogen, ammonia, &c. Most of the above are capable of destroying life when inhaled in a concentrated form, but as a rule, in escaping from the sewers into the outer air they become so diluted as to exercise but little influence on the health of the surrounding neighbourhood.

It is chiefly owing to the additional presence of living organic particles of a fermentative nature, that sewer emanations derive their power in the production of disease.

Where there is an absence of ventilation sewage-gases become highly offensive in character, but it must not be forgotten that the above *ferments* of disease may exist in these exhalations when the latter are so inodorous as to be undiscoverable by the most sensitive persons, and at the same time, be present in such quantity as fatally to infect those exposed to them.

It is now pretty well established that the ferments of most Zymotic diseases consist of minute living organisms, or germs. These germs (now described under the generic term Bacteria or Microzymes), when taken into our bodies either in foul drinking water, or inhaled as dust in the air we breathe, generate disease by their rapid growth and propagation in the system. They are present in the various secretions and excretions of the bodies of those infected, and when the bowel and other liquid discharges from such patients are thrown (as is generally the case) into the house-drains, the germs soon find their way into the sewers. Upon their arrival in the sewers they encounter conditions most favourable for their development and propagation. That this is so is evident from recent researches on the deportment and physical conditions essential to the life of these infective organisms. Dr. Burdon Saunderson in describing them and their action on the liquids in which they live, says ; "These organisms are remarkably independent of the chemical constitution of the medium in which they live provided that they are supplied with oxygen, and they take nitrogen from almost any source which contains it and use it for the building up of their own protoplasm." At the last meeting of the Royal Society a paper by Dr. Downes and Mr. Blunt was read in which they gave an account of their researches on the effect of light upon these bacteria and other animal organisms. The conclusions which these gentlemen arrived at from the results of their experiments were, that light is inimical to the development of bacteria and under favourable conditions wholly prevents their propagation, and so far from light being essential to their vitality it was shewn that its presence is not merely non-essential but positively injurious.

Now all the above provisions, so highly favourable to the growth and vital persistence of these infective disease germs, are afforded in a stagnant system of sewers more or less choked with a decomposing layer of silt ; for the sun-light is, from the position of the sewers, excluded, and the bacteria find in the putrid silt and the foul liquid that covers it as well as in the ammoniacal vapours exhaled, sufficient pabulum, if not to propagate, at least to retain their vitality.

It will now become more apparent from a consideration of the above facts why ordinary sewage gases have a less baneful effect upon those exposed to their influence than is generally supposed, but that when they contain these disease germs their character changes, and from being comparatively innocuous they become, upon admixture with specifically-infected excreta, most active agents in the spread of Zymotic disease.

Professor Cameron in his inaugural address on October 29th, to the Royal College of Surgeons, when describing these germs and their connection with disease, said, "No one need have fear of catching Typhoid fever by tending a patient affected with it, for this disease arises from foul water and sewage gases. It is most improbable that water containing ordinary animal or vegetable matter or even the sewage matter of the ordinary kinds produce Typhoid fever. The germs or microzymes that have already been thrown from the the bodies of affected persons must be in the polluted water, or must be wafted up mechanically by the sewer-gases."* The lecturer concluded by expressing his opinion that, broadly speaking, contagious diseases were all filth diseases, and could only be destroyed by the most rigid national and private cleanliness.

Dr. Leibermeister holds much the same opinion as Professor Cameron with regard to the propagation of Typhoid fever. He says, "We must recognize on the one hand that Typhoid fever is never contagious from person to person; and on the other hand, that it never originates spontaneously, but by a continuous transmission of the poison. The disease is not contagious in the proper sense of the word, for it is never transmitted by direct contact. It is not purely miasmatic, for external conditions alone are not sufficient to produce it. The presence of a person suffering from this disease, or of substances derived from such a person, is necessary. The poison is propagated continuously. It travels from the diseased individual to the localities which are favourable for its growth and multiplication, and from these localities again into the human body."

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* *British Medical Journal*, November 24th, 1877.

Numerous instances are recorded of the baneful effects of sewer-air in producing vomiting, diarrhœa, and enteric fever. Dr. Murchison in his excellent and exhaustive work on "Continued Fevers" quotes numerous instances to prove that Typhoid fever is caused either by inhaling sewer emanations, or by drinking sewage contaminated water.

Inasmuch as I consider the infantile "Summer" Diarrhœa of Leicester to be a disease of similar origin and closely allied in its nature to Typhoid fever, I must be pardoned if I draw largely upon the evidences recorded by such high authority as Dr. Murchison. He says :—

I. "In August, 1829, 20 out of 22 boys, at a school at Clapham, were seized with fever, vomiting, purging, and excessive prostration. One other boy, aged 3, had been seized with similar symptoms two days before, and died comatose in 23 hours; another boy, aged 5, died in 25 hours; all the rest recovered. Suspicions were entertained that they had been poisoned, and a rigorous investigation ensued. The only cause which could be discerned was that a drain at the back of the house which had been choked up for many years had been opened two days before the first case of illness, cleaned out, and its contents spread over a garden adjoining the boys' play ground. A most offensive effluvium escaped from the drain and the boys had watched the workmen cleaning it out. This was considered to be the cause of the disease by Drs. Latham and Chambers, and by others who personally investigated the matter. This event is mentioned first, merely from the date of its occurrence. It may fairly be objected, that the course of the disease was more rapid than what ordinarily characterizes Enteric fever, but this circumstance was accounted for by the intensity of the poison.

II. About Easter, 1848, a formidable outbreak of fever occurred in the Westminster School and the Abbey Cloisters, and for some days there was a perfect panic in the neighbourhood respecting what was called the "Westminster Fever." Within a little more than eleven days it affected thirty-six persons, all of the better class, and in three instances proved fatal. Shortly before its first appearance 'there occurred two or three days of peculiarly hot weather,' and a disagreeable stench, so powerful as to induce nausea, was complained of in the houses in question. It was found that the disease followed very exactly in its course the line of a foul and neglected sewer, in which fæcal matter had been accumulating for years without any exit, and which communicated by direct openings with the drains of all the houses in which the fever occurred. The *only* exception was that of several boys who lived in a house at a little distance, but who were in the habit of playing every day in a yard in which there were gully holes opening into the foul drain. The Metropolitan Sanitary Commission gave it a decided opinion that the epidemic 'arose from the bad state of the sewers and drains of the precinct, and especially from the foul condition of the large sewer described.'

III. Towards the end of the autumn of 1852 a fever broke out at Croydon, which attracted great attention, and was made the subject of various official reports by the Board of Health. Out of a population of about 16,000 persons, 1800 were attacked with fever, and 60 of them died. That this fever was Enteric or Typhoid is clearly shown by all the accounts of it which appeared, and also by the expressed opinion of a Committee of the Epidemiological Society, consisting of Drs. A. P. Stewart, Jenner, and Sankey. Five cases, moreover, were admitted into the London Fever Hospital, from Croydon ; all were Enteric. In the month of August an attempt had been made to drain the town by means of small stoneware pipes, which were not only of insufficient size, but were imperfectly cemented together. Dr. Arnott and Mr. Page, C.E., in their report to the Secretary of State, stated that the escape of sewer miasms had been influential in producing the epidemic. Numerous instances were mentioned in which the disease immediately followed exposure to the fœtid emanations liberated during the opening and emptying of cesspools, the cleansing of old drains and open ditches, and to the foul gases which were forced into the houses when any obstruction took place in the narrow drain-pipes.

IV. In the autumn of 1857 Enteric fever broke out in Fleet-lane, London, while a sewer was being constructed. The sewer was open from June 29th to October 30th, and during all this time the inhabitants complained of the offensive smell. Soon after the sewer was opened Diarrhœa began to appear, and Enteric fever followed. Of 140 families in the lane hardly one escaped. Dr. Letheby and Mr. Ross, who investigated the circumstances, both attributed the fever to the sewer miasms. It appeared soon after the sewer was opened, and it disappeared when the sewer was closed, and all the time it was confined to the lane and immediate neighbourhood.

In most cases, the poison is taken into the system through the air. Many instances might be cited, where, although the water-supply was the same for all, only those persons exposed to sewer-emanations have been attacked.

A more recent instance of the spread of Typhoid by means of sewer-air was described by Dr. Thorne (Medical Inspector to the Local Government Board) at the Conference on the Health and Sewage of Towns, held in May, 1877. Dr. Thorne said :

"I was sent by the Local Government Board into the North of England to inquire into a very sudden outbreak of Typhoid fever ; it was in a square of houses, two-thirds of which were affected, two-thirds of the inmates also being down with the disease. There had been no previous Typhoid fever in the square, which had an absolutely independent system of drainage, having no connection with any other houses. It was perfectly clear that the outbreak was not due to the water-supply, and for some time I was completely baffled ; but I found out afterwards that a man had had Typhoid fever at some considerable distance, and some kind neighbour, who had a little wash-house in this square, had washed some of the linen. The linen was very much soiled by his extremely liquid evacuations, he having been in a state of insensibility, they had been wrung out, and it was supposed the exceeding foulness had been washed off. They were then sent to this place and washed, the slop-water ran down into the drain which ran right round the square, and within 14 days of this so-called slop-water passing into the drain the whole place was down with Typhoid fever."

The above evidence unquestionably proves that the principal cause in the production of Typhoid fever arises from sewer emanations. That Scarlet fever may spread from one house to the other through the instrumentality of untrapped and unventilated sewers is demonstrated by an instance of the kind that came under the notice of Dr. Baldwin Latham, C.E. The case occurred at Ashford, in Kent. Here he found 30 houses in a row, and there was no direct intercourse between the occupants. A visitor came to one of these houses, having a child ill with Scarlet fever, and before a week had passed the children in the whole of the houses were affected with the disease. The houses all drained into one cesspool, and the sink of each house was untrapped and in direct communication with the cesspool.

A notable case is related by Dr. Carpenter which proves that diarrhœa may be caused by the evil odours wafted from manure manufactories, which are of a nature almost similar to sewer emanations. He says :—

"In 1847, many of the inmates of Christ Church Workhouse, Spittalfields, were seized with violent attacks of diarrhœa of an enteric type. It was found that whenever the works were actively carried on, and particularly when the wind blew from that quarter, there ensued an outbreak of diarrhœa in the Workhouse. In December of the following year, when Cholera was spreading in the neighbourhood, sixty of the children were attacked one morning with violent diarrhœa. In consequence of this outbreak the owner of the manufactory was obliged to stop work, and the children rapidly recovered. Five months afterwards the works were resumed, and again there was a similar outbreak amongst the inmates occupying the part of the building opposite the manufactory. The works were once more discontinued, and the diarrhœa ceased." *

Now the dejections of Typhoid and Scarlet fever are infectious; and if the above evidence affords undoubted proof of the spread of these diseases through their discharges being thrown into the sewers, it will be admitted that all the contagious febrile affections that are attended with specifically-infected discharges may, under like conditions, be assisted in their spread through similar channels.

The Zymotic diseases other than the above whose liquid discharges have been proved to be infectious are; Small-pox, Measles (*Hallier*), Diphtheria, and Croup.

Many cases of Zymotic disease, especially Typhoid fever, have occurred in my own practice during the last two years whose origin I could distinctly trace to sewage-gases.

Escape of Sewage-gas into Dwellings.

I shall now consider the various ways in which sewage-gas may escape into houses and into the air which surrounds them. It is a well-known fact that the prevalence of dry and sultry weather increases the amount of stench that arises from foul collections of excrementitious origin, and it is but reasonable to infer that it brings about an increased production of gases in sewers containing silt, which is also a filth accumulation. During hot and continued dry weather, a free communication is speedily established between the outer air and the sewers. The water in the traps of the street gulleys is soon, under these circumstances, entirely evaporated, and there is then nothing to interfere with the free escape of gases from the sewers; and if, as frequently happens, a cold evening succeeds a very hot day the sewer-gas, being warmer than the outer air, will issue in a regular current through such un-trapped openings. This may easily be proved by holding a lighted candle to the orifice of such a trap, its flame will be found to be blown *from* the sewer by the current of air that is passing upwards.

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* Dr. Wilson: *Hand Book of Hygiene*, page 73.

During ordinary summer weather, however, with a moderate rainfall, the gully and house-drain traps have sufficient water in them to stop this *free* communication between the outer air and the sewers. The outward passage of the enclosed gases, though much hindered, is not however entirely abolished by the water contained in ordinary traps, for they are freely absorbed by the trapping water on one side of the mid-feather, and imperceptibly given off from it on the other side This fact was pointed out by Mr. Roger Field, C.E., and the truth of it is now admitted by all engineers of any standing in the country. It is, therefore, quite a mistake to suppose that the water of traps over house-drains and in closets, especially when these are connected with badly ventilated and ill-constructed sewers, is alone sufficient to afford security against the escape of sewage-gases into houses.

If such sewers, from some obstruction, become blocked in any part of their course, or if, from being too small, they cannot discharge the entire volume of sewage as rapidly as it is received, a backing-up of their liquid contents in either case results. Under these conditions the sewage gases are entirely pent-up and, *their generation still continuing within*, pressure is soon exerted by them upon the sides of the sewers and the traps connected with them. The resistance offered by ordinary house-drain traps is so slight that it is soon overcome by this internal pressure, and the consequence is that the gases escape by bubbling-up through the water which is supposed to seal them. This bubbling-up of the gases I have repeatedly noticed and frequently drawn attention to. Under the same pressure the gases find a ready outlet through the pores and fissures of the brickwork and are forced through the surrounding soil to very considerable distances from their points of egress.

Examples are not wanting that shew how easily the soil is permeated by gases, especially when they exist under pressure. Professor Pettenkofer, of Munich, relates a case where persons were poisoned and killed through coal gas in a dwelling where no gas was laid on. The gas to reach the house had travelled through no less than twenty feet of soil under the street, and passing under the foundations gained access to the interior by rising up through the flooring of the basement rooms. Another example is afforded by an explosion that took place at Southgate which laid a dwelling in ruins. There was no gas supply to the house but the main gas pipe, which passed along the road on which it was built, had sustained some damage which caused a leakage in a part of its course almost opposite the habitation. The gas had traversed the intervening sub-soil and reached the interior of the house in such quantities that an explosion resulted. Now if coal gas is capable of passing through the soil to such distances, it is but reasonable to infer that sewage-gases under pressure can do the same. In this manner the soil surrounding *blocked* sewers may become contaminated for considerable distances by the gaseous impurities that are forced through their walls.

The houses also, in close proximity to and drained by blocked sewers, must have their subsoil polluted and surcharged by the emanations from the latter; and, when the doors and windows are closed, the heated air inside them together with the draughts of their chimneys have a tendency to quicken the upward passage through the basement floors of these disease-bearing miasms.

If a storm visit a neighbourhood, the sewers of which are in the condition above described, the sub-soil is polluted to a much greater extent. In this case the stagnant contents of the sewers are churned-up by the sudden advent of the storm-waters and, an insufficient or no outlet existing, they back up through the basement floors and gain access to the cellars of the houses. An enormous pressure is at the same time exerted upon the sewers, which is followed by a rapid leakage of sewage-matters into the sub-soil, rendering it sewage-logged, or "excrement-sodden." That such leakage does take place I have had frequent opportunities of verifying by inspecting the up-turned soil when sewers have been opened in Leicester; in all instances where the sewers were found blocked or contained much silt, the superincumbent soil, to variable distances from the sewers, gave off a most offensive odour and was found to be discoloured with black particles of finely-sifted sewage. With the microscope, I have also obtained abundant evidences of sewage pollution in samples of soil, apparently "virgin" and free from impurity, obtained from sites unbuilt upon. My observations on this point are corroborated by an instance of the kind that came under the notice of Professor Pettenkofer, at Munich. He found that the quantity of nitrogenous matter, that had escaped out of a fairly-constructed brick sewer, was so great that a cubic foot of the surrounding soil contained no less than 122 grains of organic nitrogen.

The sub-soil in badly-sewered localities, on account of the wholesale leakage that takes place during storms, is therefore everywhere saturated and contaminated with sewage impurities; and, if the sewers originally contained any excreta of persons suffering from infectious disease, the sub-soil itself becomes specifically-infected with the germs which such excreta are known to contain.

A soil, so polluted, is a reservoir for filth and infective organisms; and, in most instances, only requires the heat of a summer sun to cause it to give off an increased amount of pestilential vapours, provocative of more wide-spread disease and followed, in consequence, by a more aggravated and noticeable amount of fatality than is experienced in the cold and bracing months of winter.

* * *

CHAPTER IV.

It is necessary for the purposes of this Report that I should refer at some length to the construction and capacity of the sewers of Leicester, and some of its other sanitary requirements.

The present population of Leicester is estimated at 117,461, and for its use there are 2,020 cesspools, 5,600 water-closets, 3,000 privies, 6,700 ash-pits, and 4,400 sanitary pails.

SEWAGE WORKS.

The works for the treatment of the sewage were erected in the year 1855 by Mr. Thomas Wicksteed, C.E., and cost over £40,000. The daily sewage flow, exclusive of storm-waters, averages a little over 6,000,000 gallons. This sewage has to be lifted at the Sewage Works by steam-power to a height of 20 feet. All the appliances are in duplicate. The sewage is lifted by two 25 horse-power Cornish engines, each lifting 2,500 gallons per minute, and in addition to these there is a 20 horse-power centrifugal engine for driving the elevators, the archimedean screw, and the agitators. Connected with the latter engine there is an auxiliary centrifugal pump of one foot bore, and capable of lifting, in case of emergency, 2,000 gallons per minute. The sewage is first subjected to chemical admixture and afterwards pumped into two settling tanks, each of which is 60 feet long by 45 feet wide, and their average depth is 10 feet. The bottom of the first portion of these is made to slope towards the centre along which a culvert runs which is semi-circular at the bottom and open at the top, in the bottom of this culvert there is an archimedean screw placed, which is about 32 inches in diameter. The deposit collects upon this screw from the sloping sides and is, by the revolutions of the latter, gradually removed from the deposit tanks to the sludge well. From this position the sludge is lifted, by means of a vertically-placed ladder of endless buckets, into a trough which carries it off to various points of deposit on the works. Almost seven-eighths of the solids in the sewage are thus got rid of. To remove the remaining portion of the solids the sewage flows into two other tanks, much larger than the first pair, being 140 feet in length, by 45 feet in width, and having an average depth of seven feet. The deposit which collects in this pair of tanks is afterwards swept back into the first set. The sewage passes from the second pair of tanks through a shallow filter formed of rounded stones, and after traversing this it flows into a channel by which it reaches the river.

I shall now describe some of the sewers which convey the sewage to the Works. The Northern and Western districts of Leicester are drained by *Two Main* sewers. The North-Eastern portion of the town is drained, in great measure, by only *One Main* sewer.

1st WESTERN MAIN SEWER

commences in Walnut-street, runs along New Bridge-street, Albert-street, Asylum-street, and with a zig-zag course between Trinity Hospital and St. Mary's Church, gains Bath Lane, the entire length of which it traverses; it then runs along Friar-street, and by making two sharp bends reaches Sanvey gate, along which it courses; it afterwards follows a route through Canning-place, Canning-street, and turns into Watling-street; passing through this it goes onwards under the canal and ends in the Abbey Meadow, near a sharp turn of a branch of the river. The fall given to the section of this main, which extends from Knighton-street to the St. Margaret's end of Sanvey-gate, is 1 in 488, and the sewer for the same length has a uniform diameter of 2 feet 6 inches. The fall in the Canning-street section is 1 in 636, whilst the fall given in the remaining section, where it reaches the Meadows is 1 in 733. The sewer in Canning-street has a diameter of 3 feet 3 inches, and its diameter in the rest of its course is 3 feet 9 inches.

2nd WESTERN MAIN SEWER

begins in Dun's Lane, and making a sudden bend passes across Little Holme-street and reaches Great Holme-street; it then leaves this street and runs along a portion of Little Holme-street, then bends into Leamington-street and crossing Watts' Causeway, continues its course under the Swannington railway, and, at a varying distance, runs along the western bank of the canal and river until it reaches Alice-street in the North; crossing both this and Woodgate almost at right angles it intersects, directly afterwards by a somewhat sudden bend, Bradgate-street, Lyttleton-street, Diamond-street, and Emerald-street, at acute angles, and by another sudden turn it passes under Abbey-gate and the river, and finally terminates in "The Pasture." The fall given to this long line of main sewer is 1 in 488, and its diameter, 2 feet 6 inches, is uniform throughout its whole course. The sewer which joins the termination of this last with that of the first I have described, has a fall of 1 in 538, and a diameter of 2 feet 9 inches.

LONDON ROAD MAIN SEWER.

The central districts of Leicester are for the most part drained by one main sewer. This sewer begins at a point near Evington-lane on the London-road and passing down the whole length of this road, preserves almost a straight course through Granby-street, Gallowtree-gate, and Church-gate, at the end of which it discharges its contents into the western main that runs along Sanvey-gate. The fall given to this sewer is quite sharp on account of the configuration of the districts through which it passes.

NORTH-EASTERN MAIN.

This sewer starts at the Humberstone-road end of Curzon-street, turns up Dysart-street, runs along Benford-street, Lead-street, and passing up part of Brook-street, reaches Wharf-street, runs through Russell-square and Junction-road, and thus gains the Belgrave-road, the course of which it keeps until Sidney-street is reached, passing along this street and under the canal it traverses a long length of the "Meadows" until it reaches the main outfall sewer. The fall given to the section of this sewer, which extends from Curzon street to Russell square, is 1 in 392.

The marked sinuosity of its course, however, presents such an obstruction to the flow of sewage that the velocity arising from its fall is reduced to fully one-half. The diameter of the above section of the sewer is, throughout, *only* 2 *feet.* The form of the sewer changes in Junction-road* and from being circular it here becomes elliptical. Its diameter from Junction-road up to the end of Sidney-street is 2 feet 6 inches by 1 foot 6 inches. The diameter of the sewer from Sidney-street to where it joins the main outfall sewer, is 3 feet 6 inches by 2 feet 6 inches.

The remaining portion of the north-eastern main, as constructed by Wicksteed, runs along Woodboy-street, and crossing Foundry-square, enters Archdeacon-lane; it then turns up Harcourt-street and passing along part of Luke-street, John-street, and Canning-street, discharges its sewage into the main in Watling-street, through which the sewage of the first main sewer I described also finds an exit. The fall of this section of main sewer is 1 in 392, and its diameter is *only* 2 feet 6 inches.

MAIN OUTFALL SEWER.

This sewer which conveys almost the entire volume of sewage from each of the above sources traverses the Abbey Meadows to the Junction shaft with a fall of 1 in 912, and *its diameter for the first three or four hundred yards of its course is only* 4 *feet* 6 *inches.*

Now any one who is at all conversant with the working of sewers must admit, upon a careful perusal of the above, that the whole system from beginning to end is too cramped in capacity for the requirements of the districts which they drain. It will also be admitted that, for the sewers to be self-cleansing, the gradients or "dips" given to them (London-road excepted) are much too flat, more especially when their *lengths* are taken into account.

The main sewers are, as a direct result of their insufficiency, running full in that part of their course nearest the main out-fall sewer. As a proof of this I may here state that I found one of the Western main sewers I have already described (when its course was being altered in Bath-lane) running thirteen-fifteenths full in Sarah-street. Here the sewer had only run about half its real length and it would therefore receive, before reaching its destination, more sewage than sufficed for the complete occlusion of its remaining space.

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* This section was laid down some time ago under the supervision of Mr. Stephens, the Borough Surveyor.

Another result, the importance of which in the main question at issue cannot be over-estimated, is that *during the day the main outfall sewer in the Abbey Meadow is running full.* This is brought about not by any backing up from the Works, as many would suppose, but from the fact that the diameter of the sewer is, in itself, too small to discharge the entire sewage as rapidly as it is received by the outlying sewers.

That the main outfall sewer does run full during the day can easily be verified by tapping it; the sewage upon doing so, will be found to rise to the height of a few inches above the crown. This is the reason why the men, when engaged in clearing it of deposit, cannot work during the day but are obliged to rest from their labour until the manufactories have ceased work, and the waste water from the engines has therefore ceased to flow into the sewers. When this occurs the men can resume work and continue at it throughout the whole night, and all day on Sundays if required, until they are again driven out by the rise of water in the morning caused by the factories.

The main outfall sewer running full it follows, as a consequence, that every sharp rainfall of any duration must be attended with a backing up of the sewage contained in every main leading directly into the former, and the height attained by this back accumulation will be directly proportionate to the amount of rainfall and inversely as its duration. Every storm that visits the town must therefore be attended with greater or less sewage-logging of its sub-soil, through the universal leakage that takes place when the sewers are filled with the sewage-contaminated storm-waters. (Vide Chap. III.) As the sewers gradually relieve themselves of these waters, the flooding of the cellars which results from the above conditions, gradually subsides and leaves behind it a layer of deposit, which consists of nothing more nor less than finely-sifted solid matter derived from the sewage. This polluted state of the sub-soil and cellars arising from the insufficiency of the sewers is, for the production of disease, bad enough ; but its importance in this respect is altogether surpassed by the fact that, the main outfall sewer running full, *no ventilation* exists for the escape of the pent-up sewage gases. I say *no* ventilation, for the influence of the few ventilators that here and there stud the districts of the town have little or no effect in preventing high degrees of pressure being reached by the confined gases. The word, "ventilator," given to these appliances, though not a misnomer, is a term liable to mislead those who are not acquainted with what actually takes place where these exist in Leicester. Their use in some of the low-lying districts of the town would be better expressed by the term "blow-holes," for the gases escape from them (during warm weather and with sufficient rainfall to seal the traps throughout the town) with a rush so forcible as scarcely to be credited by anyone who has not actually witnessed it. This forcible escape of gases through the apertures is a sure indication of the degree of pressure existing in the sewers, just in the same way as the escape of coal-gas from a common gas-pipe indicates the pressure in the main. The high pressure exerted by the gases in some of the sewers in Leicester can easily be accounted for if it be remembered that few of them are, from their flat gradients, self-cleansing. Gases are continually being generated and evolved from the filth deposited in the sewers, and in quantities directly proportionate to the prevailing temperature ; these finding no outlet during the day, except through the few existing ventilators, soon realize high degrees of pressure.

Now I have shewn in the preceding chapter that, in districts where the sewers are badly constructed, ill-ventilated, and sealed :

(1). The confined and compressed gases soon escape through the traps of ordinary house-drains and contaminate the air in their immediate neighbourhood.

(2). That they also permeate and pollute the surrounding sub-soil for considerable distances on either side of the sewer from which they have just escaped.

(3). That the ingress of these gases through the floors of the houses built in proximity to the sewers, is somewhat accelerated by the suction caused by the upward draught arising from the heated air of the interior of the houses.

(4). That Diarrhœa has been proved to have arisen, in many instances, from inhaling air that is infected with sewer emanations.*

To prove therefore that the mortality, in Leicester, from "Summer" Diarrhœa arises from these emanations, it remains to be shewn:

(1). That the distribution of the disease corresponds more or less with that of the faulty sewers already described; and,

(2). That the chief infliction of the Epidemic is sustained in those localities where, from an aggravation of structural defects in the sewers, the sub-soil is most polluted with sewage matters and the atmosphere most vitiated by the escape of gases generated within the sewers.

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* Vide pages 35–36.

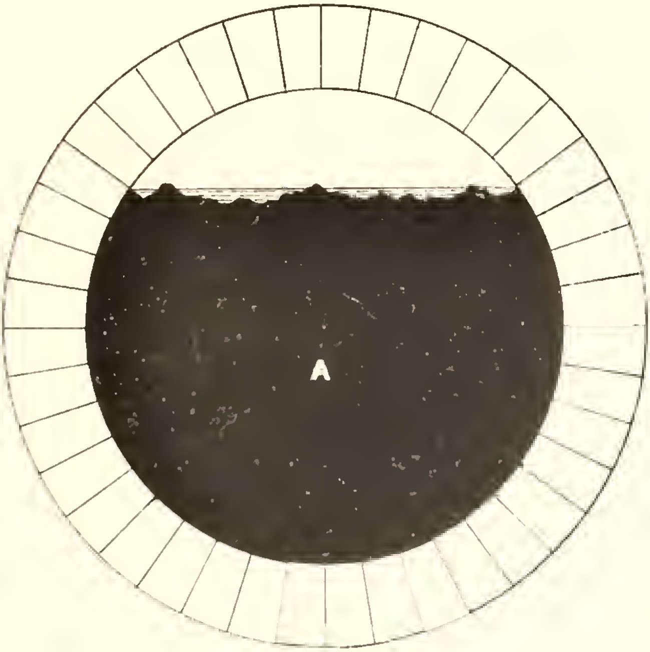
The Great Eastern sewer empties itself into the main out-fall sewer in a part of its course where the dimensions of the latter have been enlarged. I have therefore omitted a description of this sewer, as it does not affect the question at issue.

* * *

CHAPTER V.

A cold and damp sub-soil may aid in the causation of many diseases, *i.e.*, Rheumatism, Phthisis, Pneumonia, Bronchitis, &c., but the distribution of deaths from Diarrhœa, that occurred in Leicester during the summer of 1877, fully warrants me in stating that the sub-soil, geologically considered, exercises little or no influence in the production of this disease. This will be seen by referring to the disease-map for the Diarrhœa epidemic of last year. The deaths, in the portion of the town to the north of Sanvey-gate and the west of High Cross-street, are just as plentiful as they are in the district lying between Burley's-lane, Archdeacon-lane, and Wharf-street, or in that lying to the east of Wharf-street; and yet these districts are each built upon a sub-soil that differs in geological character, the first being formed of alluvial deposit and gravel, the second of sand, and the third of clay.

The deaths, as will be seen, that have taken place in the district enclosed by Belgrave-road, Archdeacon-lane, Church-gate, Humberstone-gate, Humberstone-road, and Upper Brunswick-street, are numerous, and disproportionate to those found in any other district *of equal area.* Now this district, as I have shewn, is drained by *ONE* main sewer, the diameter of which is only 2 feet in the greater part of its course, and enlarges to only 2 feet 6 inches when it enters Archdeacon-lane. Its gradient is 1 in 392, but the sinuosity of its course is so marked that the velocity of its sewage flow is more sluggish than that in any other main sewer in the town, and consequently the tendency for the deposit of silt is greater in it than in the other mains. Again, though the diameter of this sewer is smaller than the western mains, the area drained by it, if not greater, is at least equal to that of either of the western districts. Most of the subsidiary sewers are also, throughout this portion of the town, very flat; and all those that I have seen opened, contained in some part of their course considerable quantities of indurated deposit. A notable instance of this kind came under my notice when I inspected Birstall-street sewer.* This sewer is 15 inches in diameter, and for the last 35 yards of its course it contained 11½ inches of silt. This state of matters was found to extend itself for over 20 yards along the subsidiary main sewer in Willow Bridge-street that conveys the combined sewage of Syston-street and Birstall-street. There was, therefore, only 3½ inches of space in the sewer left open for the passage of the whole of the sewage and storm-waters derived from the above streets. The annexed diagram will indicate more forcibly than any description the state in which I found this sewer:



TRANSVERSE SECTION OF BIRSTALL STREET SEWER.

Size=$\frac{2}{15}$ths of real dimensions.

A.—*Accumulation of indurated deposit chiefly composed of coarsely-granular granitic debris.*

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*Since writing the above, openings have been made into the main sewers in Northgate-street and Woodboy-street; the former was found to be $\frac{2}{3}$rds. full of silt while the latter was quite full and, in both instances, most evil odours were given off from the deposit.

The clogged state of the sewer fully accounted for the out-break of Typhoid fever that took place in Birstall-street, and to discover the cause of which the sewer was opened. It also accounts for some of those deaths from Diarrhœa that have heretofore been attributed to the emanations of the "made ground" met with in this district.

I may here mention that the fatal cases from Diarrhœa, that occurred in the summer of 1877, upon all the patches of "made ground" were only 11 in number, out of a total mortality of 166, and every one of these took place in houses drained by the north-eastern main sewer that I have just described.

It will now be observed from the above description of the sewerage of the district under consideration, that all the evils I have pointed out as arising from the general insufficiency of the sewers must here prevail in the most aggravated form, and they have accordingly given rise to the greatest mortality.

The deaths that occurred from the disease, in the western and northern portions of the town on the near side of the river, require no comment with regard to their causation, for these follow the course of the main sewer with remarkable exactness.

The deaths observed over West Bridge and in the district of Charnwood-street are easily accounted for by the fact that sewer-gases are light and accumulate, as a rule, in the higher levels of districts connected with ill-ventilated sewers containing deposit. It may be asked on the other hand, and certainly not without reason, that if this accumulation of the gases takes place in the higher levels, why is it that there were not many more deaths from the disease in the higher districts on either side of the London Road? The reason is that there is a constant and rapid discharge of the sewage from these districts on account of the steep gradients of the sewers, and by reason of which they are thoroughly flushed and almost free from deposit. The gases evolved from such deposit are therefore here met with in minimum quantity, and we find that the districts drained by these sewers have enjoyed almost perfect immunity from the disease.

Of the twenty large English towns, Bristol is one that has, for some years past, experienced only a slight mortality from "Summer"

Diarrhœa. Last year, as in many previous years, it stood lowest, its death-rate from "Summer" Diarrhœa being only 1·5; on the other hand, Leicester was the highest with a death-rate of 5·6.

Now, if "Summer" Diarrhœa is, as I contend, a disease whose causation depends upon sewer-gas, the condition of the sewers in Bristol should be very different from that which I have described as existing in those of Leicester.

From an epitome of a paper by F. Ashmead, Memb. I.C.E.,* read at Bristol before the Association of Municipal and Sanitary Engineers and Surveyors, I gather that, "The sizes of the several sewers in each district of Bristol are calculated to carry 5 cubic feet or 31¼ gallons per head per diem. of a variable population of from 30,000 to 50,000 per square mile, according to the district, and a quarter of an inch of rainfall in 24 hours, storm overflows being formed in all cases where possible to provide for any greater rain-fall."

"There are at present no fewer than five separate outlets for the discharge of the sewage of the town into the tidal river. The sewers are without any external openings or means of ventilation. This non-ventilation of the sewers is unattended with evil consequences, and for the following reasons, there is a constant flow through the gradients being steep, and all the sewers laid down throughout thé town are self-cleansing and well flushed."

To give some idea of the large capacity of the main sewers of Bristol, I will here give the dimensions of one of them. The Prince-street main sewer is egg-shaped, and its diameters are 5 feet by 4 feet 6 inches. The area which it is required to drain is only 518 acres. The capacity of this main, as will be seen, is greater than the main outfall sewer of Leicester which is, nevertheless, expected to drain an area of over 2,000 acres.

The capacities of the subsidiary main sewers of Bristol are equally disproportionate to those of Leicester, and their gradients are steeper. This will be seen by the following table:

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* *Public Health*, (July, 1877.)

BRISTOL.

There are four sizes of Elliptical sewers.

	ft.	in.		ft.	in.	
1st	4	0	×	3	0	Internally.
2nd	3	3	×	2	6	
3rd	2	8	×	2	0	
4th	2	0	×	1	6	

All are 9 inches thick. Rate of fall from 1 in 60 to 1 in 360. Cylindrical drains, 1 ft. 2in. in diameter internally, 7in. thick.

LEICESTER.

The sewers are nearly all Circular.

	ft.	in.	
1st	2	6	Internally.
2nd	2	0	
3rd	1	3	
4th	10 to 12 inches.		

Most of these are only one brick thick, and the rate of fall for the larger ones is from 1 in 392 to 1 in 488.

Summary.

I have shewn in the preceding chapters :

1. That a considerable amount of infantile mortality is annually caused throughout England by the improper feeding of infants and from maternal neglect.
2. That in Leicester the fatal cases of Diarrhœa arising from the above causes could not have been disproportionate to those in other manufacturing towns.
3. That "Solar Heat" is the chief agent in generating the disease.
4. That heat, in conjunction with a water-logged sub-soil does *not* form a favourable condition for the production of the epidemic Diarrhœa of Leicester ; the greatest infliction from the disease having been sustained in a year when unusually high temperatures prevailed with little or no rainfall and, consequently, when the level of the river was at its lowest.
5. That sewage-gas is capable of giving rise to Diarrhœa, and is also the chief cause in the production of Typhoid fever, which closely corresponds to the former disease in its distribution, period of prevalence, &c.
6. That very few of the sewers laid down in Leicester are, from their flat gradients, self-cleansing.

7. That the whole system of sewerage is of insufficient capacity to meet the daily requirements of the town.

8. That as a result of this, the main out-fall sewer is running full during the day, and the main sewers directly connected with it are also in the same condition within variable distances from their points of discharge into the former

9. That little or no means of ventilation exist for the sewers in the greater part of the town.

10. That under such conditions of non-ventilation and insufficiency, the gases are completely pent-up in the sewers, where they soon attain high degrees of tension, and under which they escape into the surrounding sub-soil and outer air.

11. That the undrained "made ground" of Leicester exercises no influence in the production of the disease, the few deaths which occurred over the areas of the different patches being fully accounted for by other co-existing conditions.

12. That the distribution of the deaths from the disease corresponds more or less with that of the faulty sewers.

13. That the chief infliction of the Epidemic is sustained in those localities where, from an aggravation of structural defects in the sewers, the sub-soil is most polluted with sewage matters and the atmosphere most vitiated by the escape of gases generated within the sewers.

14. That the sewerage of Bristol is excellent and constructed on a plan that not only secures self-cleansing sewers but also admits of the least degrees of tension being reached by the contained gases.

15. That this town (Bristol) takes precedence of other large English towns for its low death-rate from "Summer" Diarrhœa.

I consider, therefore, from the above facts, *that the "Summer" Diarrhœa of Leicester is dependent upon the pollution of the air by the escape of sewage-gas from the hastily-devised, badly-constructed, non-ventilated, and unamended system of sewers.*

TYPHOID FEVER.

The deaths from this disease were only 20. This mortality is smaller than has ever been recorded since the year 1860.

A somewhat striking similarity exists between Typhoid fever and infantile Diarrhœa. Both diseases are endemic to most towns, and the period of greatest prevalence is, with few exceptions, the same for each. Diarrhœa also forms the most constant symptom of Typhoid fever, being met with in 93 per cent. of the cases affected.

In Leicester, the two diseases present additional features in common. The following table I have drawn out from the mortality returns given in the annual reports of the medical officers (Drs. Moore and Crane) for the last 25 years. It shows the total number of deaths from Typhoid fever and Diarrhœa that occurred in the Borough of Leicester during the whole of each year.

It will be observed that a rise or fall in the mortality of Typhoid fever is, for 19 of these years, accompanied by a rise or fall in the mortality experienced from Diarrhœa.

This parallelism in the degree of fatality annually arising from both diseases will be still more apparent upon reference to the accompanying chart where I have drawn their respective death-rate curves for each year since 1859.

Such a manifest and oft-repeated coincidence in the prevalence of the two diseases goes far to prove that the conditions most favourable for the development and spread of Typhoid fever are, as far as Leicester is concerned, more or less similar in nature to those that assist in the causation of Diarrhœa.

The fluctuations in the Diarrhœa death-rate curve are more marked and attain higher limits than those representing the mortality experienced from Typhoid fever, but this is only what might be expected when we consider the tender age of the majority of those who fall victims to the former disease.

TABLE IV.

	Year.	Population.	Deaths from Typhoid Fever.	Deaths from Diarrhœa.	Total Deaths.
	1853	62,164	104	138	242
	1854	62,925	101	150	251
	1855	63,686	54	113	167
	1856	64,447	34	115	149
	1857	65,208	116	202	318
	1858	65,969	92	120	212
	1859	66,730	38	104	142
Census	1860	68,056	11	56	67
	1861	68,257	61	160	221
	1862	68,797	49	99	148
	1863	72,130	51	170	221
	1864	78,337	37	180	217
	1865	80,500	56	226	282
	1866	83,750	53	147	200
	1867	86,000	49	209	258
	1868	90,000	63	349	412
	1869	91,500	57	272	329
Census	1870	95,083	52	240	292
	1871	97,500	65	303	368
	1872	100,829	64	305	369
	1873	102,515	55	314	369
	1874	106,202	48	257	305
	1875	111.000	64	308	372
	1876	113.581	43	263	306
	1877	117,461	20	185	205
		Total....	1437	4985	6422

The chart also shows that although the mortality from Diarrhœa has more or less steadily increased since the year 1860, a proportionate increase in the deaths from Typhoid fever has not been experienced during the same period. This disproportionate increase in the mortality experienced from each disease, may, in my opinion, be accounted for by the gradual and steady closing of the surface-wells in the town, the impure water from which formed one of the chief causes of Typhoid fever amongst its *adult* population.

A marked correspondence is also found to exist in the distribution throughout the town of the deaths resulting from each disease. To prove this close correspondence in the distribution of their respective deaths, I must be allowed *a number from each disease as nearly equal as possible.* Now the total deaths from Typhoid fever that occurred in Leicester during the 7 years, 1870–76, were 362, and 79 of these died in the Infirmary. The remaining 283 deaths took place in various districts of the town, and in the accompanying disease-map I have indicated their localities. On the same map I have also shewn the localities where the deaths from Diarrhœa took place during the year 1876, the total number from this cause being 263. It will be observed that the marks indicating the deaths from each disease are mingled together in a remarkable manner, the districts presenting the highest Diarrhœa mortality are those in which the greatest fatality from Typhoid fever was experienced and *vice versâ.* The two diseases are therefore very closely allied, as,

1st. The one forms the most constant symptom of the other.

2nd. Both diseases, with but few exceptions, prevail during the same season of the year.

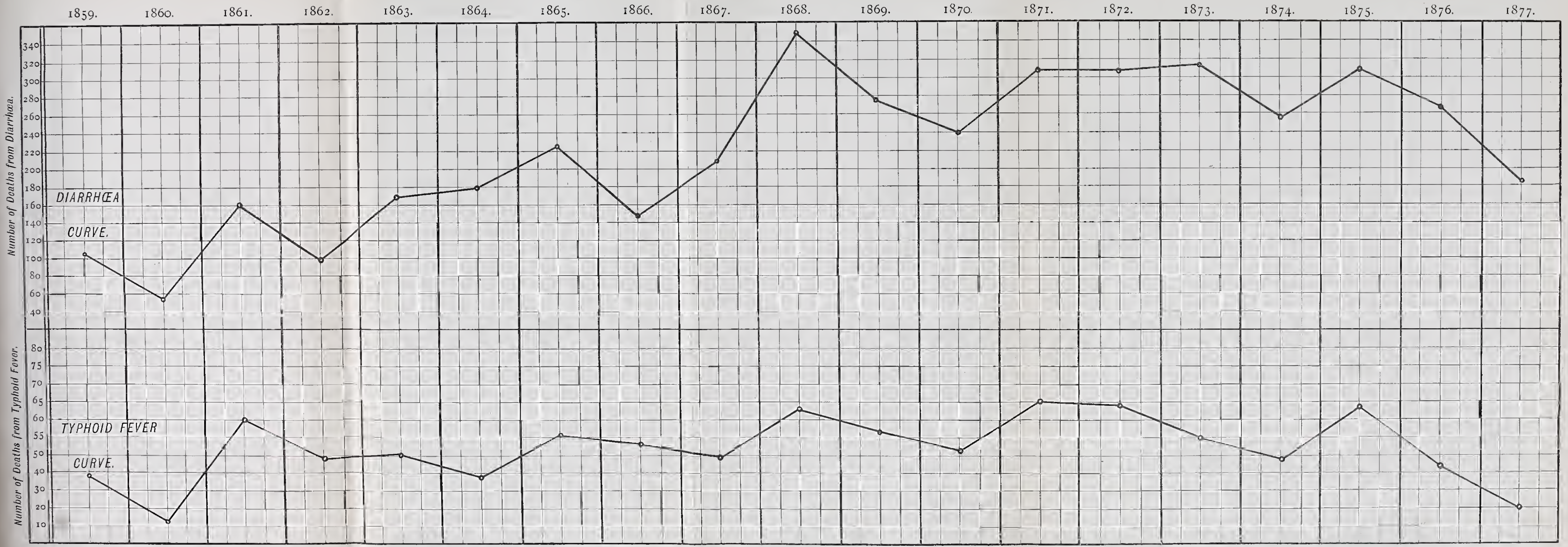
3rd. There is a remarkable parallelism in the degree of prevalence and fatality annually experienced from each.

4th. The two diseases very closely correspond in their distribution.

5th. Their origin is similar, as both arise from sewer emanations.

The above facts lead me to entertain a strong conviction *that the majority of the cases of infantile Diarrhœa are but forms of Typhoid fever, rendered irregular in their course and fatality by the depression of temperature and symptoms of extreme collapse that are induced by the profuse choleraic discharges met with in children affected with the former disease.*

CHART shewing the TOTAL DEATHS in each year from DIARRHŒA and TYPHOID FEVER for the last 19 Years.



ROYAL COLLEGE OF SURGEONS OF ENGLAND
21 MAY 90
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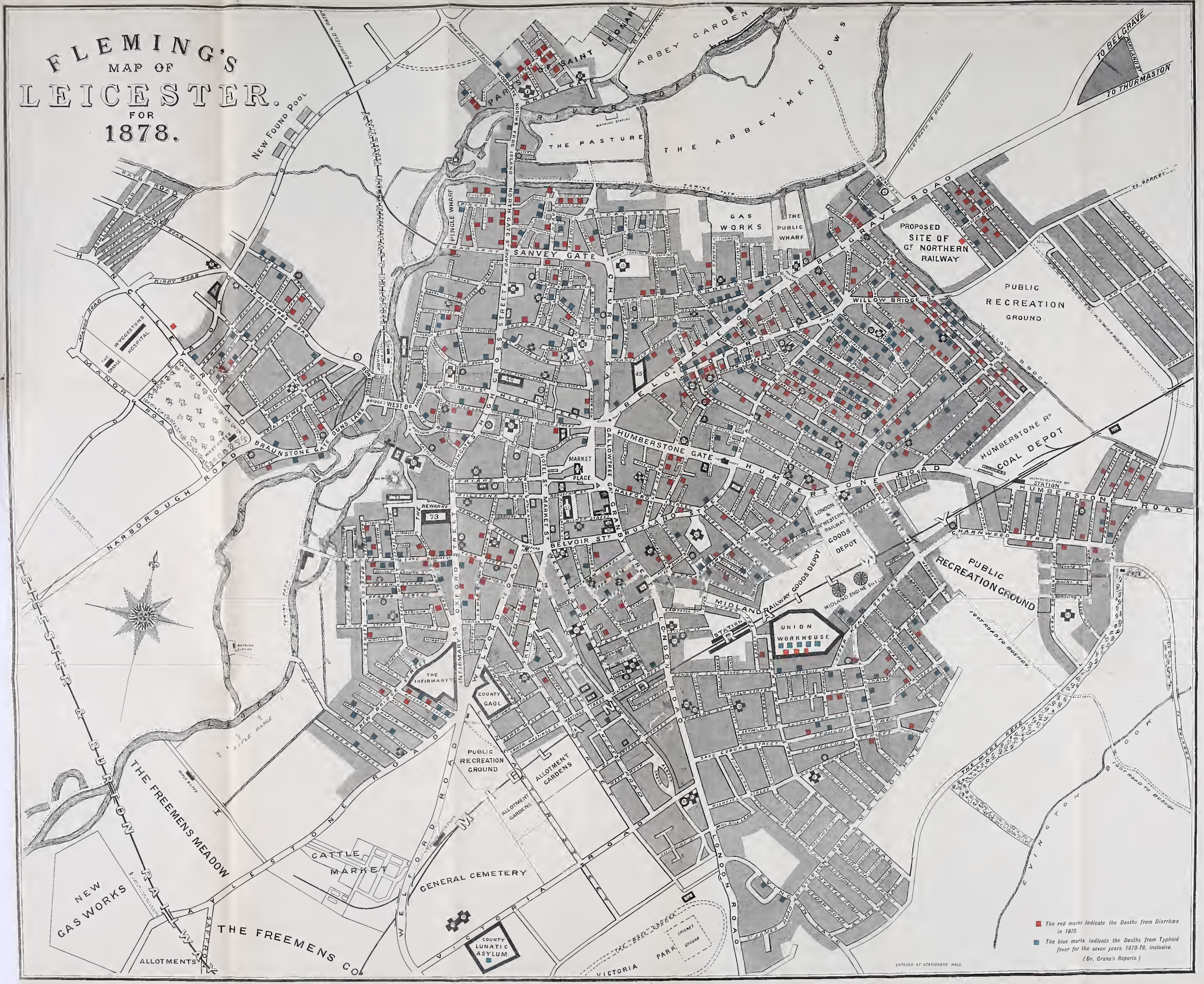


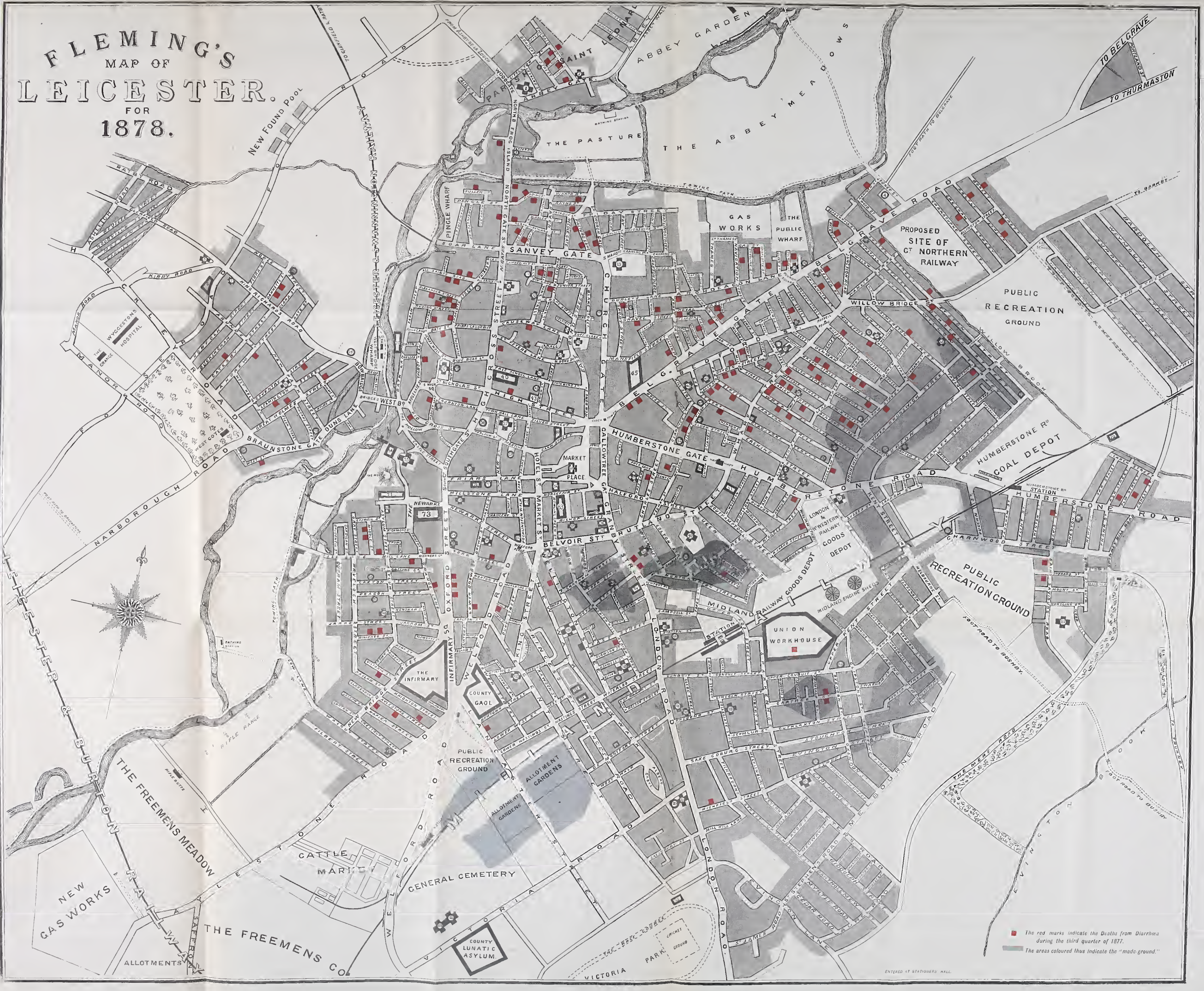
FLEMING'S MAP OF LEICESTER. FOR 1878.

🟥 The red marks indicate the Deaths from Diarrhœa in 1878.

🟦 The blue marks indicate the Deaths from Typhoid fever for the seven years, 1870-76, inclusive.

(Dr. Crane's Reports.)

ENTERED AT STATIONERS' HALL.



FLEMING'S MAP OF LEICESTER. FOR 1878.

🟥 The red marks indicate the Deaths from Diarrhœa during the third quarter of 1877.

▨ The areas coloured thus indicate the "made-ground."

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GEONS OF ENGLAND
ARY

APPENDIX

TO THE

REPORT

OF THE

ASSISTANT OFFICER OF HEALTH,

1877.

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METEOROLOGICAL OBSERVATIONS TAKEN AT THE MUSEUM, LEICESTER, DURING THE *JULY* MONTH OF THE FIVE FOLLOWING YEARS.

	1866.			1868.			1875.			1876.			1877.		
	Max Temp	Min Temp	Rain in Ins	Max. Temp.	Min. Temp.	Rain in Ins	Max. Temp	Min. Temp.	Rain in Ins	Max. Temp.	Min. Temp.	Rain in Ins.	Max. Temp.	Min. Temp.	Rain in Ins.
1	70·5	47		74	55		70·0	57·5	·02	72·0	56·9		67·7	56·2	
2	68·5	44	·10	75	57		68·9	54·4	·53	70·0	58·4		67·8	49·0	
3	65·0	42		78	54		61·8	54·1	·15	72·2	49·4		64·1	51·2	·01
4	69·0	47·5	·08	67	44		66·7	50·9		72·8	59·3		65·1	46·8	·28
5	66·5	44	·25	72·5	50		71·0	45·9		72·6	60·0	·01	64·9	45·5	·05
6	66·5	44	·05	70	44		72·5	49·8		74·5	49·5	·25	62·0	46·8	·10
7	69·5	44	·01	80	50		68·4	50·4		72·5	60·0	·04	62·1	44·9	·01
8	68·5	49		81·5	55		71·9	55·0	·01	70·7	58·7		60·0	44·4	·10
9	77	55	·01	82·5	55		64·0	56·1	·45	69·5	53·4		65·6	49·8	·02
10	84	51		87	55		63·1	52·0	·13	63·7	51·3	·03	73·2	57·1	
11	89	54·4		84	54		58·7	46·0	·07	63·9	52·9		67·5	56·0	·03
12	92·5	60·5		81	54		59·9	50·4		69·8	43·7		67·8	48·4	
13	90·5	53		82·5	53		63·1	43·6		79·2	52·6		70·1	50·6	·03
14	84·5	52		89	52		59·0	50·8	1·07	85·4	55·8		68·8	57·2	·73
15	81·5	54·5		98	56		59·7	51·7	·29	85·8	60·6		65·0	56·4	·02
16	79	53		94·5	61		62·6	52·2		87·9	58·4		61·0	54·0	·43
17	68	41		75	49·5		68·3	52·5	·01	77·3	59·9		63·8	55·0	·02
18	76	42		80	60		71·8	56·5	·17	74·9	51·0		65·1	52·9	
19	67	43		76	51		64·9	58·9	·63	75·7	60·0		67·4	47·1	·01
20	73·5	43		88	58		70·6	59·1	2·18	74·9	54·5		64·0	49·0	
21	80	49		94·5	62·5		66·4	55·0	·39	82·3	51·1		66·8	48·1	
22	72·5	44		98·5	59		66·0	56·0		84·1	60·9		66·5	54·0	
23	70	50		66	41		70·0	54 5	·06	71·8	58·7	·07	67·1	59·9	·48
24	62	51		76	52 5		64.9	52·7	·02	73·8	56·3		68·4	52·0	
25	66	53·5		82	47		63.6	45·0	·23	77·3	54·4		66·2	51·0	·28
26	72	55		92	57		66·4	43·7		77·0	53·6	·08	69·6	54·4	
27	74	57		88	54·5		69·9	45·4		68·2	52·0	·11	66·1	53·7	·05
28	73	54	·05	95	52·5		72·0	50·8		67·6	53·4	·01	64·3	49·5	·01
29	64·5	46	1·02	74	49		74·4	50·0	·01	66·5	54·0		77·7	62·0	
30	65·5	46	·14	81·5	52·5		67·9	57·2		73·4	52·5		77·1	56·0	
31	57	43	·50	74	41		65·9	48·0		66·7	52·5	·11	73·8	58·4	
	Averages.		Total.	Averages.		Total.	Averages.		Total.	Averages.		Total.	Averages		Total.
	73*	48·8	2·21	81·7	52·7	Nil.	66·6	51·7	6·42	74·0	52·4	·71	66·9	52·1	2·65

* Fahrenheit's Scale.

METEOROLOGICAL OBSERVATIONS TAKEN AT THE MUSEUM, LEICESTER, DURING THE *AUGUST* MONTH OF THE FIVE FOLLOWING YEARS.

	1866.			1868.			1875.			1876.			1877.		
	Max. Temp.	Min. Temp.	Rain in Ins.	Max. Temp.	Min. Temp.	Rain in Ins	Max. Temp.	Min. Temp.	Rain in Ins	Max. Temp	Min. Temp	Rain in Ins	Max. Temp.	Min Temp.	Rain in Ins.
1	76	55		87·5	52		65·1	47·0		64·2	45·2		66·8	51·8	
2	70·5	53·5	·14	95	59		67·1	44.3		72·0	46·7	·36	64·4	46·8	
3	71	48·5	·01	91	58		61·4	47·0	·10	68·0	54·9		62·9	50·4	·02
4	64	49		95	54		62·3	48·2		65·2	53·2	·03	64·4	50·7	
5	66	46	·06	97	60		66·2	47·5	·03	69·7	52·8		73·2	51·7	
6	59	50	·01	84	59	0·75	69·4	57·0	·24	69·4	51·5	·03	73·9	55·0	·04
7	68·5	46·5	·18	77	49		64·6	56·9	·79	77·4	57·9		70·1	61·0	·20
8	67	46·5	·09	74	46	0·06	71·7	58·1	·29	73·8	54·2		69·2	53·8	·12
9	64	44	·50	77	46		70·7	58·6	·11	83·2	49·4		68·1	57·9	·06
10	66.5	44·5	·10	85	55		69·2	57·5	·13	71·0	56·0		63·8	55·5	
11	70.5	50	·01	74	50	0·20	72·3	58·3	·12	78·0	48·0		66·1	50·6	
12	66	53	·04	73	51		68·4	57·9	·44	81·4	51·5		65·2	50·5	·02
13	74	46	·53	71	45	0·20	69·8	56·6	·04	91·5	55·0		69·9	56·0	
14	66·5	50	·07	75	52		73·7	56·5	·07	91·9	60·0		71·3	58·4	·02
15	64	46		82	47		74·2	60·0		84·7	58·3	·34	72·0	58·1	
16	64·5	47		73	56	0·10	83·2	58·3		83·1	62·3		71·7	55·0	·05
17	63	41	·06	65	54	0·15	74·5	53·9	·01	81·0	56·0		68·1	52·8	
18	71	41		69	51	1·44	71·5	57·2		73·1	63·0	·24	70·9	53·1	·18
19	81	52		58	50	0·11	69·4	51·4		73·1	59·8	·04	68·4	59·0	·38
20	70·5	55		67	47		70·5	50·1		74·0	57·0		78·2	54·1	·01
21	64	54	·02	70	49	0·20	69·0	49·0		76·7	56·6		70·0	58·4	·06
22	74	47	·03	64	50	0·03	71·5	52·4	.	66·2	56·4		66·0	52·3	·15
23	74	55		66	46	0·02	69.4	52·3		64·2	45·3		60·7	44·1	
24	71	47		65	42		70·6	50·9		60·3	42·8	·11	65·8	42·1	
25	75.5	54	·02	67	42		71.0	59·0		61·3	38·1		61·0	52·0	·20
26	79	56	·16	69	54	0·14	71·3	60·4		58·7	38·0	·10	63·1	56·3	·42
27	73	50		67	45		68·0	52·1		61·9	51·4	·16	67·1	54·2	·62
28	74	53	·30	61	46		66·1	50·0	10	65·0	51·0	·47	68·1	55·0	
29	61	49·5	1·30	67	47		67·5	54·0		60·9	53·0		67·1	51·4	
30	68	40	·97	75	54		64·8	50·0	·17	63·8	49·9	.12	65·2	52·5	
31	73	44	·01	71	44		63·1	52·2		56·9	44·1	·11	61·2	46·9	·05
	Averages.		Total.	Averages.		Total.	Averages.		Total.	Averages		Total.	Averages.		Total.
	*69.3	48·8	4·41	74·5	50·3	4.00	69·2	53·7	2·64	71·6	52·2	2·11	67·5	53·1	2·58

* Fahrenheit's Scale.

METEOROLOGICAL OBSERVATIONS TAKEN AT THE MUSEUM, LEICESTER, DURING THE *SEPTEMBER* MONTH OF THE FIVE FOLLOWING YEARS.

	1866.			1868.			1875.			1876.			1877.		
	Max. Temp.	Min. Temp.	Rain in Ins.	Max. Temp.	Min. Temp.	Rain in Ins.	Max. Temp.	Min. Temp.	Rain in Ins.	Max. Temp.	Min. Temp.	Rain in Ins.	Max. Temp.	Min. Temp.	Rain in Ins.
1	73	46·6		71	43		67·9	45·7		64·8	51·9	·01	60·8	42·3	
2	66·5	44·5	·50	76	50		66·4	58.8	·17	60·7	48·5	·16	58·5	44·0	·18
3	65	47	·21	86	54		66·8	54·5	·14	61·7	49·0	·43	52·9	45·0	·53
4	65	47	·65	84	48		64·7	51·8		68·9	49·0	·15	58·3	44·9	
5	65	50	·63	89	53		68·8	53·8		67·9	57·0	·15	60·1	39·5	
6	72	55	·35	90	51		70·2	51·0		63·8	57·0	·07	61·1	44·0	
7	63·5	48·5	·21	90	55		74·4	54·0	·01	63·0	52·0	·04	57·6	47·9	
8	63	51	·08	64	48		67·9	55·0	·06	59·3	44·9		60·8	39·7	
9	67	53·5	·24	74	40		65·8	52·4		61·0	46·0	·12	61·9	47·5	
10	73	49·5		77	41		65·0	44·5		60·0	46·4	·01	61·7	47·9	
11	63	41	·24	79	50		69·4	45·8	·01	57·4	48·0		64·1	53·9	·36
12	60	49·5		57	43		62·9	53·1		53·9	46·1	·02	65·0	54·1	·06
13	66	52·5		62	44		72·8	56·5	·01	55·0	44·3		61·6	51·1	·04
14	62	44	·09	58	44		68·3	55·5		60·3	48·2		63·4	58·1	·29
15	64	43		66	44		68·2	53·0		61.8	41·8		63·0	54·5	·01
16	61	42	·11	66	46		70·8	53·7	·03	59·0	42·6	·09	63·8	45·0	
17	64	36	·36	69	44		73·4	52·5		65·3	48·5	·25	58·6	40·5	·01
18	64	44	·02	62·5	44		71·9	54·2		60·8	47·0	·78	61·3	46·7	
19	65	46	·06	71	47	0·21	78·1	53·5	·06	64·1	46·5		56·7	52·6	·04
20	61	46		66·5	49	0·14	69·0	56·8	·08	67·0	43·9		57·0	46·9	
21	61	45	·18	73	53	0·43	61·0	50·4	·78	70·7	50·2		56·7	39·0	
22	59	39	·32	65	41		59·8	53·7	·10	69·6	51·3	·62	56·0	39·1	·02
23	67	44	·06	65	39		54.5	50·6	·76	64·4	56·3	·37	58·5	46·5	
24	62	42	·05	67·5	38		57·4	50·2	·27	60·2	52·2	·36	56·9	44·0	
25	67	52·5	·48	58	40		65.9	51·8	·02	62·8	53·8	·06	52·0	35·4	·01
26	65	49	·06	70	44	0·66	65·2	50·1	·01	62·0	50·9	·26	59·8	42·0	
27	69	51	·10	70	47	0·49	62·0	49·0	·11	59.5	52·2	·47	60·5	41·0	
28	60	54	·23	65	49	0·21	59·7	49·6	03	55·9	51·0	·71	61·4	36·1	
29	66	53	·13	65	44	0·05	59·2	44·7		59·5	44·8	·02	61·6	37·3	
30	62	53	·07	55	43	0·42	59·9	49·0	·12	53·9	49·8	.41	60·4	46·6	·01
	Averages.		Total.	Averages.		Total.	Averages.		Total.	Averages.		Total.	Averages.		Total.
	*64.7	47·3	5·43	70·3	46·0	2.61	66·2	51·8	2·77	62·1	49·0	5·56	59·7	45·3	1·56

* Fahrenheit's Scale.

Streets in which Deaths from Diarrhœa occurred, and the number in each. 1876.

A

Abbey-street	1
Alfred-street	1
Arnold-street	1
Archdeacon-lane	1
Asylum-street	1
Argyle-street	6
Alice-street	2
Ash-street	2

B

Bakehouse-lane	1
Baker-street	2
Bedford-street and Courts	7
Bedford-street, Little	1
Belgrave-gate	4
Benford-street	2
Berners-street	1
Bond-street, Sharp's-yard	1
Bond-street, New	1
Bonner's-lane and Courts	2
Bread-street	1
Britannia-street	1
Brougham-street	1
Brook-street	2
Brown-st., Yard and Courts	3
Brunswick-street	1
Brunswick-street, Upper	3
Burgess street	1
Burley's-lane and Courts	2
Birstall-street	6
Byron-street	1
Buckingham-street	1

C

Calais-place	1
Catesby-street	1
Carley-street	3
Causeway-lane	1
Charlotte-street	2
Charles-street and Courts	3
Chester-street	1
Christow-street	2
Clara-street Cottages	1
Clipstone-street	1
Cobden-street	2
Collins'-yard	1
Conduit-street, Upper	1
Coventry-street	1
Crafton-street	1
Clara-street and Place	2
Curzon-street	3
Charnwood-street	5
Cranbourne-street	1
Coach and Horses-yard	2

D

Dane's Hill Farm	1
Dane's-yard	1

Denman-street	2
Denmark-street	1
Dover-street	1
Dryden-street	1
Duke-street	1
Dorset-street	2
Diamond-street	1

E

Eaton-street	1
Elm-street	2
Evington-street	1

F

Fennel-street	1
Fleet-street	1
Fox-street	1
Foxon-street	1
Fuller-street	2
Frank-street	3
Fairfax-street	1

G

Gartree-street and Cottages	2
George-street	1
Gosling-street	1
Gower-street	1
Grange-lane Yard	1
Gray-street	1
Grove-street	1
Gordon-street	1
Gresham-street	1
Grape-street	1

H

Halford-street	2
Harvey-lane	1
Havelock-street	1
Heanor-street	2
High-cross-street (N. & S.)	2
Holme-street	1
Hull-street	1
Humberstone-road, Humberstone-gate	2
Henry-street	1

J

James-street	1
Jarrom-street	1
Jewry-wall-street	1
Junction-road	1

K

Kent-street, Royal	1
Knighton-street	3

L

Lead-street	1
Leadenhall street	3
Lee street	2
Lewin-street	2
Littleton-street	8
Little-grove-street	1

M

Mansfield-street	1
Melton-street	1
Metcalf-street	4
Midland-street, (Hubbard's yard)	1
Middle-street	1
Mill-lane (Newark Terrace)	1
Milton-street	1
Morledge-street	1

Melville terrace	1
Mursell-street	1

N

Neale-street	1
New-bridge-street	1
New-park-street	1
Northgate-street and Courts	8
Northampton-street	1
Northumberland-road, Northgate-street	1

O

Oxford-street	1
Oak-street	1

P

Painter-street	1
Palmerstone-street	1
Pasture-lane	1
Providence-place	1
Public Wharf-yard, Belgrave road	1
Porter-street	1
Pentonville-yard	1
Preston-street	1

R

Rathbone-place	1
Rawson-street	1
Regent-street, Welford-road	1
Richard-street	1
Ruding-street	1
Rutland-street	1
Rayns-street	1

S

Sanvy-gate	3
Silver-street	1
Slater-street	1
Soar-lane Wharf	1
Southampton-street	1
Southgates	1
St. George's-street	2
Stamford-street	1
Stoughtonstreet	1
Swaffham-street	1
Syston-street	3

T

Thames-street	1
Thornton-lane	2

U

Union	3

V

Vauxhall-street	1

W

Wanlip-street	1
Waring-street	2
Warrington-street	2
Welford-road, Welford-place	1
Wellington-street	1
West-street	1
Wharf-street	1
Willow-street	9
Wilton-street	1
Woodboy-street	1
Wheat-street	1

Y

Yeoman-street	2
York-street	1
York-street (Welford-road)	3
Total	263

List of Streets in which Deaths from Fever have occurred, and number in each, for the Seven years, 1870-76 inclusive.

A

Alice-street	1
Abbey-street	2
Archdeacon-lane	4
Alexander-street	1
Arundel-street	1
Applegate-street	1
Asylum-street	2
Argyll-street	1
Arthur-street	1
Alfred-terrace	1

B

Buckingham-street	2
Belgrave-gate	8
Braunstone-gate	2
Birstall-street	3
Burley's-lane	1
Blake-street	1
Bay-street	2
Blackfriars-street	2
Blueboar-lane	1
Bonner's-lane	1
Britannia-street	2
Brunswick-street, Upper	1
Burgess-street	1
Brunswick-street	5
Brierley-street	1
Bedford-street	2
Braunstone-gate	1
Bond-street, East	2
Brook-street	1
Bond-street, New	1
Bonner's-lane and Courts	2

C

Catesby-street	2
Causeway-lane	2
Chester-street	5
Christow-street	2
Cobden-street	3
Coventry-street	1
Crab-street	1
Craven-street	3
Crafton-street	4
Church-gate	4
Church-gate, Lower	1
Colton-street	1
Cranbourn-street	2
Chestnut-street	1
Clipstone-street	3
Constitution-hill	1
Crescent, (King-street)	1
Curzon-street	4
County Asylum	1
Chancery-street	1

Conduit-street, Upper	3
Curzon-street	1
Cardigan-street	1
Cheapside	1
Caroline-street	1

D

Denman-street	2
Dryden-street	2
Dun's-lane	1
Dysart-street	1
De Montfort-square	1
Dover-street	1
Dorset-street	1

E

Evington-lane	2
Eaton-street	1
Elbow-lane	1

F

Frog Island	2
Frank-street	2
Foundry-lane	1
Friday-street	1
Filbert-street	1

G

Grange-lane	1
Grape-street	3
Great Holme-street	1
Garton-street	2
Gower-street	1
Gray-street	2
Gresham-street	2
Garden-street	3
Gladstone-street	1
Gravel-street	1
Guthlaxton-street	1

H

Hinckley-road	1
Humberstone-terrace	1
Hutchinson-street	2
Highcross-street	3
Hampden-street	1
Havelock-street	1

J

Johnson-street	2
John-street	1

K

Knighton-street	4
Kent-street, Upper	1
Kent-street	1

L

Lead-street	1
Lee-street	1
Laxton-street	1
Lord-street	1
Lewin-street	1

M

Metcalf-street	1
Milton-street	2
Maynard-street	1
Mill-lane	3
Mill-lane, Old	1
Mursell-street	1
Melville-street	1
Melville-terrace	1
Mansfield-street	1

N

Neale-street	1
Nichols-street	1
New Bridge-street	1

Noble-street	7
Northgate-street	3
Nicholas-street	1
Northumberland-street	1
Narborough-road	1
New Parliament-street	1
O	
Oxford-street	1
Oxford-terrace	1
P	
Painter-street	1
Palmerstone-street	1
Penton Villa	1
Porter-street	1
Providence-place	5
Peel-street	1
R	
Redcross-street	2
Richard-street	2
Rodney-street	1
Royal East-street	4
Rudkin-street	1
Russell-street	5
Rutland-street	1
Russell-street	1
Ruding-street	1
Russell-square	1
S	
Sycamore-lane	1
Swan-street	1
St. George's-row	1
Swaffham-street	1
Stamford-street	1
St. James'-street	1
St. George-street	3
St. John-street	1
Stoughton-street	1
Syston-street	3
Silver-street	1
St. Peter's-lane	1
Sanvey-gate	1
Shenton-street	1
Simpson-street	1
Southgate-street	1
T	
Thornton-lane	1
Thomas-street	2
Townhall-lane	2
Taylor-street	2
U	
Union Workhouse	5
Underhill-street	1
V	
Vauxhall-street	1
W	
Wellington-street	2
Wharf-street	4
Willow-street	3
Wood-street	3
Woodboy-street	2
Willows, The	1
Waterloo-street	1
Woodgate-street	1
Walnut-street	1
Wright-street	1
Wheat-street	2
Willow Cottages	1
Willow-street, Lower	1
Woodgate	1
Total	283

List of Houses in which Deaths from the principal Zymotic Diseases have taken place in 1877.

MEASLES.

18, Bath-lane
48, Asylum-street
48, Friars Causeway
8, Sanvey-gate
5, Court C, Redcross-street
10, Harvey-lane
20, Talbot-lane
12, Middle-street
10, West-st., Braunstone-gate
86, King Richard's-road
23, Emerald-street
131, Great Holme street
89, Emerald-street
31, Dannett's-street
All Saints'-road
26, Asylum-street
Fuller-street
23, North Bridge-place
30, Burgess-street
47, Northgate-street
50, Sanvey-gate
3, Baker-street, Belgrave-gate
28, Watling-street
4, Russell-square
1, Watling-street
34, Dover-street
New Yard, Navigation-street
25, Humberstone-gate
56, Humberstone-gate
82, Argyle-street
24, Rudkin-street
3, Navigation-street
28, Gladstone-street
7, Sanvey-gate
16, Court C, Sanvey-gate
12, Britannia-street

TYPHOID FEVER.

Infirmary
Do.
3, Victoria-parade
60, Eaton-street
50, William-street
16, London-road
165, Upper Conduit-street
16, Painter-street
61, Burley's-lane
18, Upper Fox-street
Bartholomew-street
78, Clipstone-street

24, Davis-street
1, St. Margaret's-street
Palmerston-street
17, Upper Kent-street
37, Wharf-street
33½, Albion-hill
163, Syston-street
26, Porter-street

SCARLET FEVER.

28, Lancaster-street
10, Woodgate
71, Buckingham-street
48, Alexander-street
36, Lower Redcross-street
96, King Richard's-road
3, Alice-street
15, All Saints'-road
Do. do.
42, Abbey-gate
13, Wright-st., St. Peter's-lane
20, Lower Vine-street
9, Crown-street
6, Court T, Sanvey-gate
88, Highcross-street
23, Goswell-street
9, Johnson's Yard, Sycamore lane
47, Northgate-street
16, Kent street, New Bridge street
45, Humberstone-road
45, do.
4, Brunswick-terrace, Palmerston-street
19, Birstall-street
2, Canning-street
24½, Upper Charles-street
5, Court D, Northgate-street
12, Dryden-street
15, Clipstone-street
Biddulph-street
15, Clipstone-street
Biddulph-street
44, Belgrave-gate
67, Denman-street

WHOOPING COUGH.

47, Laxton-street
15, Burgess-street
25, Friars-causeway
19, Blue Boar-lane
2, James's-street, Welford-road
34, Vauxhall-street
3, Court M, Sanvey-gate
35, Knighton-street
23, Long-lane
10, Garton-place
20, Knighton-street
31, Bradgate-street
97, Welford-road
7, Burgess-street
48, Dannett's-street
18, Crystal-street

27, Little Holme-street
Bow Bridge-street
125, Dorset-street
123, Syston-street
3, Noble's Yard, Wood-street, Belgrave-road
Sherrad-street
Cedar-road
32, Cobden-street
56, Argyle-street
7, Elm-street
40, Albion-hill
231, Birstall-street
3, Crane-street
Sherrad-street
1, Crane-street
13, Court C, Sanvey-gate
5, Do. do.
11, Devonshire-street
2, Archdeacon-lane
174, Curzon-street
55, Archdeacon-lane
34, Brierley-street
31, Northumberland-street
210, Birstall-street
26, Spitalhouse-street
16, Court C, Sanvey-gate
33, Russell-street
2, Gartree-terrace
32, Cranbourne-street
19½, Bow-street
10, Wharf-street
3, Rathbone-place
Saxe-Cobourg street
64, Denman-street
3, Barston-street
87, Brunswick-street
11, Birstall-street
Gardiner's Yard, Belgrave-gate
6, Court L, Belgrave-gate
1, Little Brunswick-street
6, East Goscote-street
56, Queen-street
1, Blythe-terrace, Upper Fox street
Granby-street
25, Samuel-street
13, Waterloo-street
175, Dorset-street
9, Court C, Humberstone-gate

DIPHTHERIA.

10, Ruding-street, The Friars
18, Kate-street
16, Clara-street
7, Carlton-street
Infirmary
1, Old Mill-lane
70, Stanley-street
10, Pasture-lane
63, Belgrave-gate

SMALL-POX.

Birstall-street	1
Chester-street	3
Gresham-street	1

The Names of the Streets where Deaths from Diarrhœa occurred during the three months ending September 30th, 1877, and the number in each.

A.

All Saints'-road	4
Andrew-street	1
Aylestone-street	2
Alexander-street (Friar's)	2
Abbey-gate	1
Albion-street	1
Ash-street	1
Alford-terrace	2
Archdeacon-lane	1
Argyle-street	2
Abbey-street	1

B.

Bonner's-lane	1
Bishop Blaize-yard	1
Burgess-street	1
Blackfriars'-street	1
Birstall-street	3
Belgrave-gate	3
Brougham-street	1
Belgrave-road	1
Brook-street	4
Brierly-street	1
Britannia-street	1
Bedford-street	1

C.

Catesby-street	1
Charlotte-street (Friar's)	1
Castle-street	1
Coventry-street	1
Charlotte-street	1
Christow-street	1
Chester-street	2
Charles-street	1
Carley-street	4

D

Dannett's-street	2
Denman-street	2
Davis-street	1
Diamond-street	1
Dryden-street	3
Dorset-street	2

E

Emerald-street	3
Eaton street	1
Elm-street	1

F

Fuller's-street	1
Friar's-causeway	1

Fleet-street	1
Foundry-lane	1
Forest-road	1
Foundry-square	1

G

Granby-street	2
Grange-lane	1
Gosling-street	1
Great Holme-street	1
Gartree-street	2
George-street	1
Garden-street	1
Gresham-street	1
Gravel-street	1
Gas-street	1

H

Highcross-street	1
Harvey-lane	1
High-street	1
Harding-street	2
Heanor-street	1
Hampden-street	1
Highfield-street	1
Humberstone-road	1

J

James'-street (Welford-road)	1
Junction-road	1

L

Leamington-street	1
Lower Vine-street	2
Lower Brown-street	1
Lancaster-street	1
Little Holme-street	1
Lee-street	1
Lewin-street	2
Lower Church-gate	1
Lower Garden-street	1
Lower Hill-street	1

M

Middle-street	2
Mill-lane	2
Melton-street	1

N

Northgate-street	4
New Bridge-street	1
North Bridge-place	1
Navigation-street	1
New-lane	1
Nelson-square	1
New-road	1

O

Oxford-street	3
Old Mill-lane	1
Occupation-road	1
Orchard-street	2

P

Pike-street	1
Pasture-lane	3
Palmerston-street	1
Painter-street	2
Peel-street	1

R

Ruding-street	2
Redcross-street	1

Rayns-street	1
Russell-street	1

S

Syston-street	2
Sherrard-street	1

T

Thornton-lane	1
Talbot-lane	1

U

Upper Hill-street	2

W

Wellington-street	1
Winifred-street	2
West-street, Braunstone-gate	1
Whart-street	3
Wood-street	1
Wheat-street	2
William-street	1
Workhouse	1

Y

York-street, Welford-road	1
Total	162